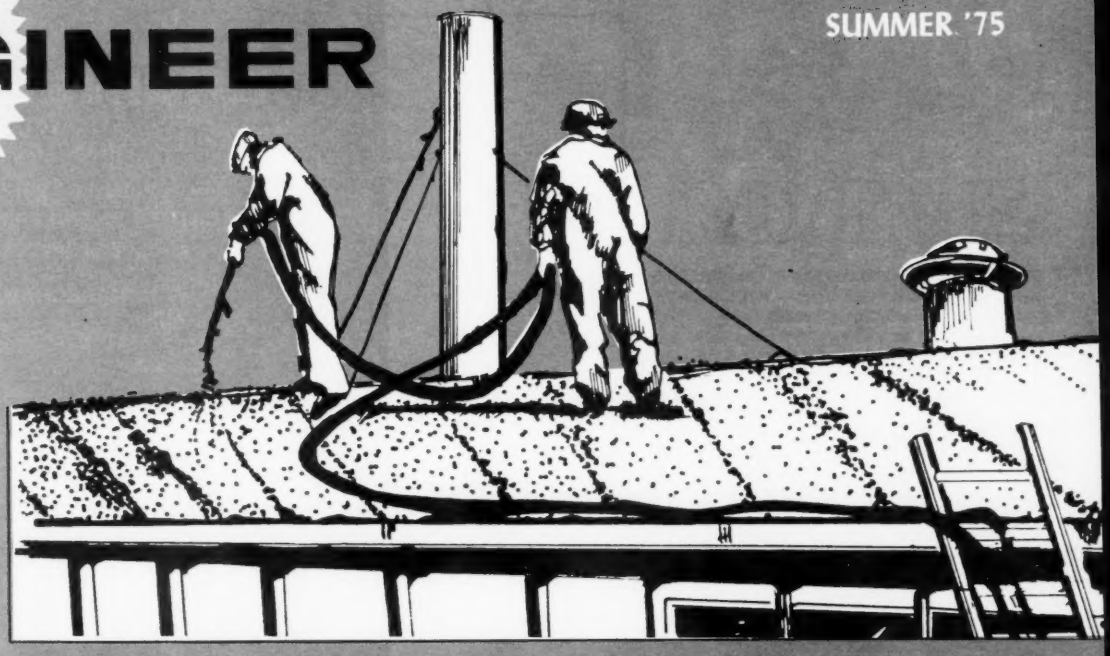
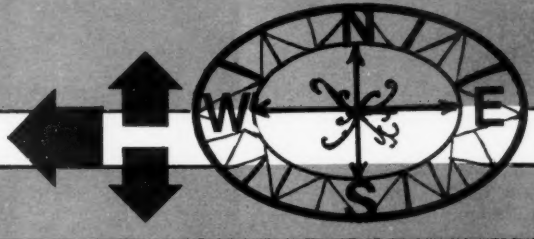
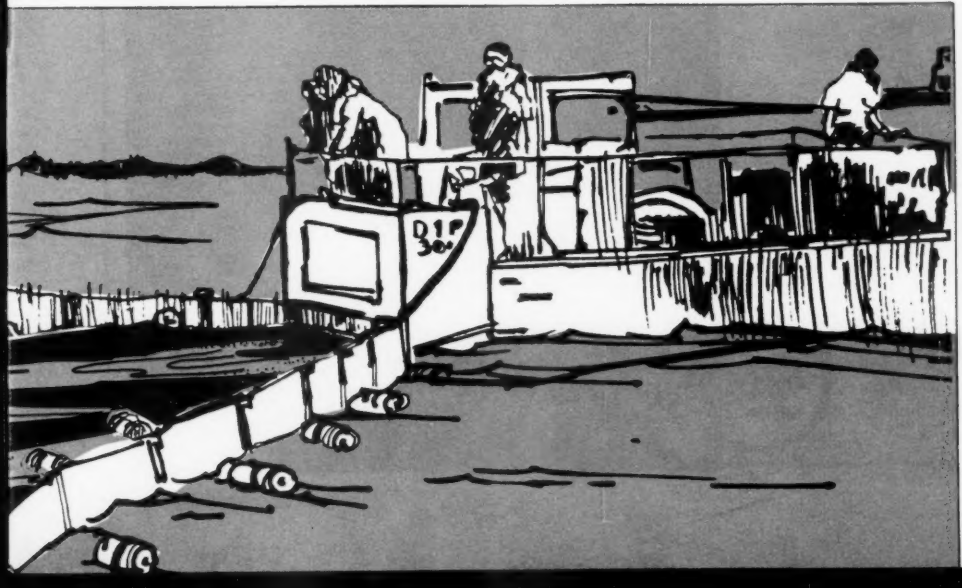
NAVY CIVIL ENGINEER

SUMMER '75







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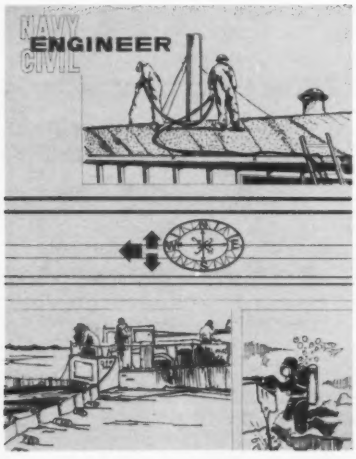

A composite of late developments of the Naval Facilities Engineering Command (NAVFAC) and its research arm, the Civil Engineering Laboratory, is illustrated by CEL artist Linda Phelps. Other illustrations throughout this edition of *The Navy Civil Engineering* related to other Research, Development, Testing and Evaluation tasks of NAVFAC and CEL are the artistic works of Doug Philips, head of CEL's graphics department.

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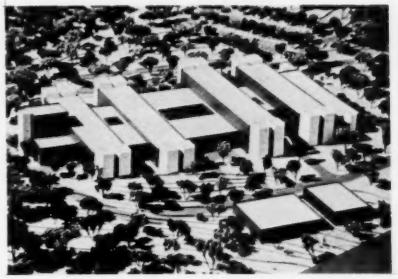
RDT&E

RESEARCH, DEVELOPMENT, TESTING AND EVALUATION — New devices and new ideas in the Naval Facilities Engineering Command are featured throughout this issue and are identified by the initials of conclusive experiment.

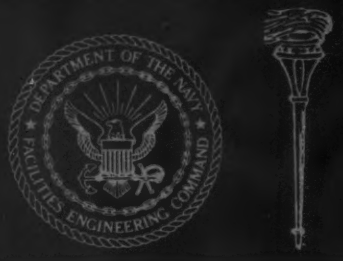


TRIDENT! The massive construction effort now underway by the Naval Facilities Engineering Command in Washington state to berth the Navy's new deterrent weapon the *Trident* submarine is told for the first time on page 44.

CONSTANT ENEMY of most man made objects, corrosion and how to combat certain forms, is related on page 38. Solutions to other day-to-day maintenance problems is featured in the Public Works Technical Notes starting on page 31.

RDT&E

Research, Development, Testing and Evaluation



By J. T. Rohrer
NavFac Plans and Programs

Naval Facilities Engineering Command is responsible for research and development related to the facilities in the Navy Shore Establishment. The emphasis is on timely research, development, test and evaluation of new and improved materials, equipment, or techniques which will help solve specific field problems associated with shore and seafloor related facilities and the Navy and Marine Corps construction forces.

How R&D funds are distributed

The size of the R&D budget averages between $10 and $12 million annually, depending on flucutations caused by changing needs or priorities. The dollars are distributed approximately as follows.

Environmental protection

The fact that environmental protection occupies the largest portion of the budget is indicative of the increased emphasis on pollution abatement in recent years. Included in this are tasks concerning harbor pollution, oil spills, smoke abatement, oily wastewater treatment, noise abatement, and solid waste disposal.

Amphibious-advanced base

The amphibious and advanced base effort supports both the Naval and Marine Corps construction forces and includes tasks on ship-to-shore container off-loading, improved equipment and techniques for the Marines and Seabees — such as expeditionary shelters, fuel transfer and storage, expedient surfacing, protective construction, and cargo handling ashore.

Shore facilities

Support for shore facilities includes electrical utilities, VLF antenna insulators, structures, fire protection, waterfront corrosion control, and evaluation of materials.

Energy conservation

Energy conservation is a relatively new and timely addition to the spectrum of RDT&E efforts. Efforts include investigation of energy conservation techniques, alternate energy sources—such as solar energy—and local energy sources—such as geothermal energy.

Ocean Engineering

Ocean engineering involves construction of surface and subsurface ocean facilities. Current tasks include the investigation of soil properties and foundations, underwater construction equipment and techniques, and anchors and moorings.

Where the NAVFAC R&D dollars go

NAVFAC's principal research and development center is the Civil Engineering Laboratory (CEL) at the Naval Construction Battalion Center in Port Hueneme, Calif. As can be seen from the following chart, over two-thirds of our effort is accomplished at the CEL.

	Thousands of dollars
CEL	7,500
Other Navy Labs	3,200
Other Govt., Industry, and University Labs	100

CEL also receives support from sponsors other than NAVFAC: NAVSEA, NAVELEX, NAVAIR, Marine Corps, Army, and other DOD and government organizations, and this year has projects totalling some $14 million.

RDT&E Assistance

To take utmost advantage of a viable R&D community, it is vital new technology (software or hardware) be made available to the field as soon as possible. To speed delivery, NAVFAC annually allocates some $200,000 in RDT&E funds for the Civil Engineering Laboratory (CEL) to provide RDT&E assistance to field activities on their requirements and requests.

currently underway at Headquarters, Naval Facilities Engineering Command and the Civil Engineering Laboratory

The Facilities Engineering Support Office (FESO) within CEL provides quick response service at no charge to field activities. Response is available at Autovon 360-4070 (Gene Early). Calls can be made around the clock.

Techdata Sheets and Rap Briefs

To make technical information more readily available, readable and understood, CEL has developed several new styles of technology transfer. One format, *Techdata Sheets*, advises the reader about solutions to problems and lists CEL recommendations in an easy-to-read, easy-to-comprehend one-page flyer which can be kept in a three-ring notebook for handy reference.

If more information is desired, the name and phone number of the laboratory contact is listed on the back of the Techdata Sheet.

RAP Briefs provide up-to-date information on work in progress at CEL. You may want to talk with the person at the lab who is working in your field of interest, or you may ask to be included on the mailing list for subsequent published results.

The sooner updated suggestions and recommendations are made available to the field, the quicker the solution. *Techdata Sheets* and *RAP Briefs* are distributed automatically to Public Works Officers, Public Works Centers, major OICCs, EFDs and staff Civil Engineering Officers listed in the CEC Directory.

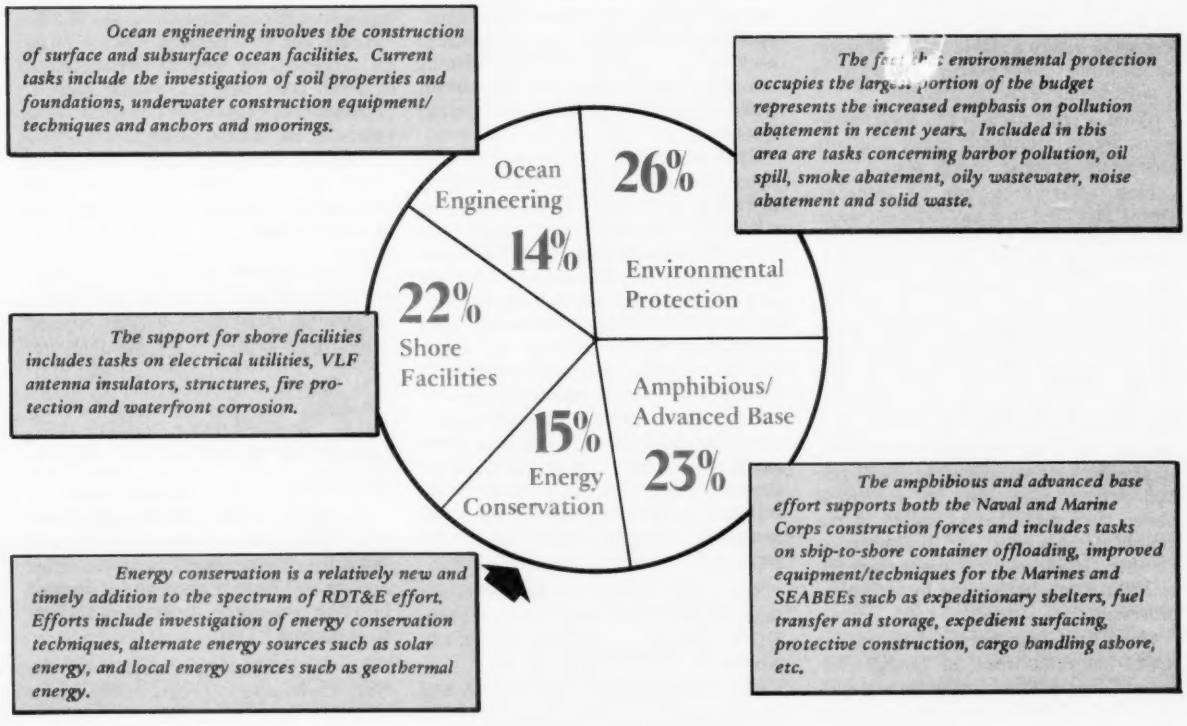
NAVFAC considers it imperative that constant contact—a two-way avenue of communication—with the man in the field be established and continually improved. To avoid a communication blackout, an RDT&E Liaison Engineer works at each Engineering Field Division. He is the local contact for channelling R&D know-how to the field man looking for a better solution to a problem.

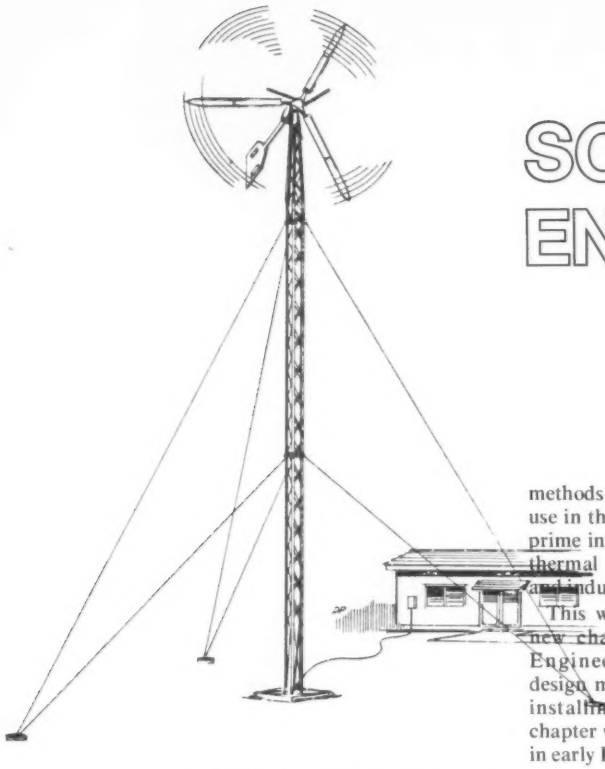
The Liaison Engineer listens and looks while in the field. He may hear or see situations or predicaments suitable for NAVFAC's R&D program. He is also interested in local innovative solutions that could be developed for navywide use. Following is a list of RDT&E Liaison Engineers. Keep their telephone numbers on hand. Give them a call if you have a problem or a solution.

RDT&E Liaison Engineers

CHESDIV	Tim Rohrer	Autovon 221-8535
LANTDIV	Dave Gurganus	Autovon 690-1175
NORTHDIV	Ed Humm	Autovon 443-4871
PACDIV	Bill Young	Commercial 808-471-3100
SOUTHDIV	Al Byrd	Autovon 794-3709
WESTDIV	Walt Cowell	Autovon 859-2549

The ultimate goal of R&D is to provide useable products—in the form of hardware, methods, techniques, or revised criteria—to solve problems quickly.


Ocean engineering involves the construction of surface and subsurface ocean facilities. Current tasks include the investigation of soil properties and foundations, underwater construction equipment/ techniques and anchors and moorings.
The fact that environmental protection occupies the largest portion of the budget represents the increased emphasis on pollution abatement in recent years. Included in this area are tasks concerning harbor pollution, oil spill, smoke abatement, oily wastewater, noise abatement and solid waste.
Ocean Engineering 14%
26% Environmental Protection
22% Shore Facilities
Amphibious/ Advanced Base 23%
15% Energy Conservation
The support for shore facilities includes tasks on electrical utilities, VLF antenna insulators, structures, fire protection and waterfront corrosion.
The ampbibious and advanced base effort supports both the Naval and Marine Corps construction forces and includes tasks on ship-to-shore container offloading, improved equipment/techniques for the Marines and SEABEEs such as expeditionary shelters, fuel transfer and storage, expedient surfacing, protective construction, cargo handling ashore, etc.
Energy conservation is a relatively new and timely addition to the spectrum of RDT&E effort. Efforts include investigation of energy conservation techniques, alternate energy sources such as solar energy, and local energy sources such as geothermal energy.



SOLAR ENERGY

By LTJG J. M. Baker, CEC, USNR
Project Engineer,
Energy Program Office

Solar energy is a popular topic these days. For the first time in modern history, there is no longer an abundance of energy available from petroleum products.

Mankind will have to convert rapidly to renewable or unlimited sources of energy to assure a stable source of power in the future. Solar energy appears to be a most desirable energy source.

What is the nature of this solar energy beast we so confidently claim will provide all of our future energy needs?

First, solar energy can be gathered, stored and used in many different ways: the familiar solar flat plate or parabolic mirror collector for space and water heating or air conditioning; photovoltaic solar cells for electric power directly from the sun's rays; wind generators for electric power from solar energy stored in winds; ocean thermal gradient heat pumps for thermal power from the ocean heated by the sun; geothermal wells for thermal power from solar energy stored inside the earth; tide and current generators for electrical power from solar energy stored in the motion of the oceans; and bioconversion for thermal and electric power from the conversion of solar energy by biological processes.

The Civil Engineering Laboratory (CEL) has established an Energy Program Office (EPO) to monitor state-of-the-art advances in solar energy and to evaluate and recommend the best methods of implementing solar energy use in the naval shore establishment. Of prime interest is the application of solar thermal collectors to Navy residential and industrial buildings.

This work included preparation of a new chapter in the Naval Facilities Engineering Command (NAVFAC) design manual on recommendations for installing solar heating systems. The chapter will be available from NAVFAC in early FY76.

Evaluation of a solar flat plate collector system for space heating installed at NAD Hawthorne, Nev., is also being conducted. Several swimming pools, previously heated by natural gas, have been redesigned for solar heating using an engineering-economic study developed by the EPO. Other projects include architectural and insulating building retrofits to increase the efficiency of the building for use with solar energy systems.

EPO is also involved in the National Solar Heating and Cooling Demonstration Act, CEL has proposed working with the National Aeronautics and Space Administration (NASA) on evaluation of the various solar heating and cooling systems including monitoring and evaluating several dozen "pilot demonstrations."

CEL may also work with the Energy Research and Development Administration (ERDA) and the Department of Housing and Urban Development (HUD) on the 50-100 large-scale demonstration units to be built at military activities, based on recommended systems from the NASA program.

The large number of demonstration units to be constructed assures many DOD activities in the United States will receive one or more of the units.

CEL intends to work with NASA and ERDA on photovoltaic power systems including research and development and a demonstration program. Photovoltaic power systems convert sunlight directly into electrical power. They are now being used to power U.S. Forestry Service lookout stations, offshore oil platforms, and other remote locations.

Future residential or commercial buildings may have most (or all) of their electrical power provided from the sun in this manner. But the primary short term application is seen at remote naval sites.

A group proposal to ERDA is being prepared by CEL, Naval Research Laboratory and several universities for funds to design and install photovoltaic power systems at naval activities.

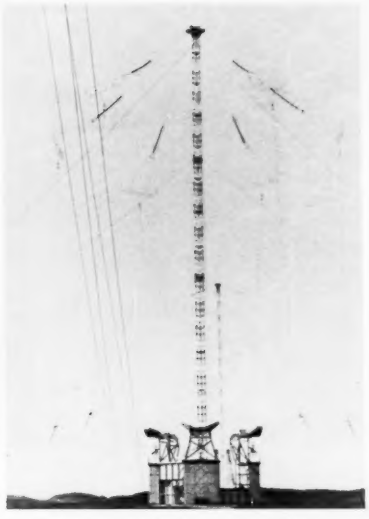
CEL has purchased a 5kw wind generator for installation on San Nicolas Island, off the Ventura County coast. The generator will be connected to various non-frequency critical loads to demonstrate feasibility at that naval installation. A comprehensive study of all economically feasible "wind power sites" also has been made. Most naval installations situated near oceans are good wind locations.

Ocean thermal gradient heat pumps are being intensively studied for use in providing large-scale power. CEL is conducting research for the National Science Foundation (NSF) in this area. The hardware required will be large, extending 100 feet or more into the ocean. When proven feasible these systems will become a power source of the future.

The future of solar heating and power systems appears very "sunny" and hopefully commercially-available solar heating will have progressed far enough to allow the Navy to begin installing solar units in FY76.

For additional information on the Navy's solar energy program, the reader is invited to contact CEL at Autovon 360-5561.

Shore Communications



The Civil Engineering Laboratory (CEL) is involved in a series of research projects to solve specific problems and improve technology of naval shore-based communications facilities.

Antennas with their towers and cables are integral components of any reliable military communications system. Many naval communications VLF antennas are guyed towers. Other configurations include valley spans or networks of cables suspended by arrays of towers. Since tower heights can reach 1,500 feet they are exposed to high winds.

For example, ground level winds in North Carolina exceed 130 miles per hour, equivalent to speeds of 359 mph at a height of 1,000 feet as determined by the two-seventh root variation law.

One apparent wind-related problem investigated by CEL concerns the fracture of strands of VLF antenna cable at NRS Cutler, Me. The 1½ inch diameter hollowcore Everdur B Cable system, with a suspended length of about 1,500 feet, consists of 37 inner hollowcore copper tubes surrounded by 39 outer solid wires.

Rated breaking strength of the cable is 62 kips minimum. During the past three summers, x-ray inspections detected internal cracks where the cable ends meet the swage terminators. To determine vibrational behavior of cable, accelerometers and a differential deflection gage were installed.

Before installation, the telemetry instrumentation was tested for corona protection and RF field effects at a temporary VLF test station. Computer analyses predicted cable behavior at the swaged end.

Another computer analysis is being performed to determine the dynamic response of antenna towers to guy line breakage. Initially, a general analytical method will be applied to determine the natural frequency and static and dynamic responses of a typical wind-located multi-level guyed tower without guy breakage.

To verify results, a 1,500-foot high VLF tower has been instrumented with accelerometers mounted at five different guy levels and anemometers placed at two elevations. Response to wind velocities from 5 to 20 mph was recorded on magnetic tape for subsequent determination of fundamental mode shapes. Static analysis was performed with a three-dimensional nonlinear guyed tower program for a design wind load of 100 mph. *Stanley Takahashi.*

The Civil Engineering Laboratory also is developing technology to improve antenna insulators. The present practice is to purchase insulators designed, developed and manufactured for the electrical power industry.

But the combination of mechanical and electrical loads on newer and more powerful VLF antennas has resulted in a large increase in the number of insulator overload failures.

For example, failures of newly installed tower-base insulator assemblies at Annapolis and Hawaii resulted in both antenna systems being shut down for about two years. Another example of insulator failure can be found in the North Central Omega Navigation Antenna, North Dakota. Several failsafe guy line insulators shattered during an electrical storm.

CEL then conducted structural load tests on a spare Omega guy line insulator assembly built with four legs (station post insulators) and with provisions to include a fifth redundant leg. Strain and deflection measurements for loads up to twice the design working load indicated possible instability for the four insulator configuration.

The insulator system is being modeled on the computer to avoid expensive testing of similar assemblies.

Stress analyses and load distribution studies of both hollow and solid core insulators are being conducted. The studies involve finite element computer, photoelastic, and strain gage measurement techniques of insulators under both laboratory and field loads.

Cone and post-type insulators have been mechanically loaded to their breaking points to determine failure modes and future patterns.

Heating of insulators when loaded electrically, both at VLF and at 60 Hz, was monitored remotely with infrared radiation sensitive equipment. Results are being analyzed by computer modeling techniques to identify sources of localized hot spots induced by VLF loads.

Efforts to develop improved insulator systems, including use of such alternate materials as glass-ceramics, have resulted in a patent application. *John Norbutas.*

NRS Cutler has requested CEL assistance in cleaning guy lines and protecting them from corrosion. The cables cannot be cleaned and coated in place because of tower height, 1,500 feet in some instances, and guy line diameters as large a 3¼ inches. Neither can they be removed for treatment on the ground.

A cleaning-coating system operable from the ground was needed and CEL arranged fabrication of experimental models. They were field tested by CEL on a simulated antenna guy line.

The models show promise, but require modification before being made practical. Public Works personnel at Cutler are making the needed changes which include reduction of weight and configuration of the application equipment and replacement of steel with plastic brushes on cleaning equipment. *Dr. Richard Drisko*

Eight lamps in the darkness

Locations plotted on the map are the eight sites of the Omega system, an all-weather worldwide navigation system. All sites, except the Southwest Pacific, are slated to be activated by late 1975. Four of the sites are already on the air and the Argentine site should be activated soon.

THE ΩMEGA SYSTEM

By J. A. BROCKWELL, CDR, CEC, USN
CHESDIV,
Communications/Electronics Facilities Project Office
• Washington, D.C.

The hope of navigators — an all-weather, worldwide navigation system — is soon to become a reality. Through the cooperative effort of the United States and five other governments, seven stations of the planned eight-station, worldwide Omega Navigation System will be operational by early 1976. The eighth station, to be located in the southwest Pacific, is the subject of current diplomatic discussions, and a firm site has not as yet been established.

Omega, a hyperbolic radio navigation technique, is the innovation of J. A. Pierce of Harvard University, who was a principal contributor to the Loran electromagnetic navigational system developed during World War II. Omega utilizes a phase difference versus Loran's pulse time difference of signals transmitted from fixed earth stations.

Research, development, and testing of such signals in the very low frequency (VLF) range of 10 - 14 kilohertz took place during the 1950s. In 1962 it was determined that a continuous, passive, worldwide radio navigation system was possible utilizing the Omega technique. In 1965 the Navy's Omega Project Office, of the Naval Electronics System Command (NAVELEX), was organized; and the following year Omega research and development stations were constructed in Norway, Trinidad, Hawaii, and New York. While these stations were not in the best relative geographic locations, they did prove that a worldwide system was feasible.

The first permanent station was constructed at La Moure, N.D., with the Commanding Officer, Chesapeake Division, Naval Facilities Engineering Command, as the officer in charge of construction. The station consists of a transmitting antenna (a 1200-foot, top-hat loaded tower), a helix building, a transmitter building, a remote monitor site, and an administration building. All of the stations have these same basic elements although various antenna structures have been used.

The North Dakota station went on the air in October 1972 under the operational control the U.S. Coast Guard.

1,200-foot Omega tower with failsafe insulators on downguys.

Two of the R&D stations, Norway and Hawaii, were upgraded to permanent status and followed North Dakota transmitting at 14-month intervals. These two stations employ valley spans for the antenna structure. The remaining stations utilize antenna towers similar to the North Dakota site. Overall system coordination is effected by the U.S. Coast Guard Omega Navigation System Operations Detail (ONSOD).

Each station transmits continuous wave signals of three VLF navigation frequencies at 10.2, 13.5, and 11⅓ kilohertz at 10 kilowatts radiated power plus two additional unique frequencies in the 11.55 - 13.1 kilohertz range. Transmissions from each station at each frequency are for periods of one second each and are synchronous with, but unique from, the transmission pattern of the other stations. Cesium time standards are used to assure synchronization with a deviation of only one microsecond. The eight-station sequenced pattern of transmission totals 10 seconds and is continuously repeated.

Accuracy is limited by variations in signal propogation with day to night change in the height of the ionosphere which, with the earth's surface, acts as a waveguide for the VLF signals. Omega generated positions of latitude and longitude are accurate to within one nautical mile during the day and two nautical miles at night. The effective range of each station is 8,000 miles north, east, and south and 4,000 miles west.

The Chesapeake Division, NAVFAC has been involved with the project as consultant to and construction agent for NAVELEX. The construction agent for the Hawaii station was the Pacific Division, NAVFAC. CHESDIV has also furnished design consultation services to the foreign governments. The construction contracts for the North Dakota and Liberia stations were administered by CHESDIV through on-site residents while contracts between CHESDIV and the involved organizations in Norway and Argentina provided for the construction of the stations in those countries.

In addition, CHESDIV contracts provided the tower structures and antennas for Argentina and La Reunion. Electronic equipment installation was accomplished by the Naval Electronic Systems Engineering Center at Great Lakes.

The antenna towers are 12-foot equilateral triangular steel frame structures braced by five (1200-foot towers) or six (1400-foot towers) levels of vertically displayed, bridge strand guys. Sixteen equally-spaced, top radial antenna wires made of alumweld conductor are anchored 2400 feet from the tower base. The insulated towers rest on base insulator assemblies consisting of two tiers of eight post insulators. Structural guys for insulated towers and all top radials are insulated by strain-and-fail-safe insulators.

The antenna top hat assembly is fed by a feed top radial (for grounded towers) or by radio frequency (RF) transmission lines (for insulated towers) through a down lead cage assembly, an RF insulator stack tripod and an RF feed-through bushing located on the roof of the helix building.

The 4000-sf helix building contains the helix tuning coil, six fine-tuning variometers, RF vacuum relays, an RF tuning transformer, and repair spaces. The transmitter building houses in its 7000-sf the primary and alternate AN/FRT-88 transmitters, the AN/FRN-30 timing and control set, an emergency battery power supply, a dummy load resistance bank, a 500-KW emergency diesel-electric generator, and repair and administration spaces.

The remote monitor site, required for signal control, consists of VLF receivers, a signal processor, and a VLF data link to the station transmitter building.

Omega provides all-weather, worldwide navigation to any vessel or aircraft equipped with a relatively inexpensive, commercially available receiver. Its purpose is to serve all nations with a dependable, low-cost means of navigation whatever the time of day, the weather, or geographic location. Omega is international in scope, peaceful in purpose, and dedicated to the safety of mariners and aviators anywhere on the surface or above the globe.

Location	Antenna Structure	Construction Agent	Operating Agent	On-Air
La Moure, North Dakota	1200 ft. Insulated Tower	CHESDIV	U.S. Coast Guard	Oct. 1972
Bratland, Norway	11,000 ft. Valley Span	CHESDIV/NTA	Norwegian Telecommunications Administration	Dec 1973
Haiku, Hawaii	7000 ft. Valley Span	PACDIV	U.S. Coast Guard	Feb 1975
Tsushima Is., Japan	1500 ft. Insulated Tower	JMSA	Japanese Maritime Safety Agency	Apr 1975
Golofo Nuevo, Argentina	1200 ft. Insulated Tower	CHESDIV/ ARGNAV	Argentine Navy	Mid CY 1975
Monrovia, Liberia	1400 ft. Grounded Tower	CHESDIV	Liberian Ministry of Transportation	Late CY 1975
La Reunion Island	1400 ft. Grounded Tower	CHESDIV/ FR. Navy	French Navy	Early CY 1976
(Southwest Pacific)	?	?	?	?

Location, tower type, operator, and activation dates for the eight Omega sites.

Transmitter building at the Norway Omega station near the Arctic Circle.

Argentine Omega station under construction in Patagonia.

Helix building at the Liberia Omega station.

By R. J. Taylor
and D. G. True
Senior Civil Engineers

Three propellant actuated anchors, CEL 10K, CEL 20K and CEL 100K, have been developed by the Civil Engineering Laboratory, Port Hueneme. Each anchor name designates its nominal long term holding capacity in kips.

Two of the anchors are used by various military organizations. Interest in all three is rapidly spreading to other governmental agencies, as well as to the commercial sector. The 10K anchor was fabricated recently and is still undergoing land testing.

Advantages of propellant anchors are many. They resist loads in any direction, are highly efficient, function in any seafloor, soft clay to basalt, do not require dragging to embed, and greatly decrease the amount and size of line, chain and connective apparatus required.

The CEL 20K anchor originally was designed for deep sea applications, including anchoring weather buoys, research vessels, instrument arrays, and many other surface and subsurface structures. Deep ocean application

Continued page 11

The CEL-developed 20K propellant anchor is lowered into the water from a warping tug. The upper section contains the firing assembly and the lower section is a sand fluke.

New Anchors Are 'Moor(ish)'

The Navy achieved a milestone in anchor technology when eighteen propellant actuated anchors were fired successfully into a coral seafloor at the U.S. Naval Communications Station on Diego Garcia in the Indian Ocean, to establish two large mooring systems for tankers from 38,000 to 54,000 DWT (Dead Weight Tons).

The accomplishment marked the first time such anchors have been used to provide permanent moorings.

The Navy's Civil Engineering Laboratory (CEL), Port Hueneme, Calif., designed and developed the 100K (nominal long-term holding capacity in kilopounds or "kips") anchor. After emplacement, each anchor was proof tested to 100,000-120,000 pounds in direct uplift. A few select anchors also were proof tested in excess of 150,000 pounds.

The propellant anchor system was used after conventional anchors failed to provide adequate mooring for tankers. Conventional anchors could not embed properly and perform as designed in the coral seafloor.

CEL project engineers D. G. True and R. J. Taylor served as technical representatives during the Diego Garcia operation. They said it took eight days to install 18 anchors and the procedure was smoother toward the end when personnel became more familiar with equipment and techniques. In fact, the last 8 anchors were installed in less than 2½ days. True and Taylor worked with the Navy's Underwater Construction Team One to install the anchors and build the moorings.

Each anchor was fired into the coral ocean bottom to depths varying from 26 to 35 feet. Anchor sizes varied from two and a half feet by five feet long to three and a half feet by seven feet long.

Two four-point spread moorings were constructed; two anchors were emplaced at each mooring point with the load equalized between each anchor to provide redundancy.

A novel method of anchor emplacement was used successfully with no major problems. Crews worked off two YC barges. One was used to fire the anchors and the other recovered the piston and test-pulled the anchor. An LCM-8 craft guided the barge carrying the anchor which was assembled and hanging by crane off the bow.

When over an anchor point marked by a surface buoy, the crane lowered the anchor to the seafloor within 5 seconds. The projectile was fired into the coral seafloor on command from the control barge.

Once the first anchor point was established the barge was essentially moored, thus the second anchor could be easily installed. Then the equalizer, a short length of chain and the mooring buoy were attached.

This operation in water depths ranging from 50 to 80 feet was accomplished four times for each mooring site. Of particular significance is that one four-point spread mooring, using the propellant anchor, needed less chain and fittings than one conventional anchor mooring leg.

The Ocean Engineering Office of the Chesapeake Division of the Naval Facilities Engineering Command (NAVFAC) made the arrangements for using the propellant actuated anchor in these moorings.

DDT&E

Anchor (cont.)

Continued from page 10

required the anchor be inexpensive. Therefore, existing ammunition components and simplified structural shapes were used.

The fact the system is cheap and highly efficient, particularly in nearshore seafloor materials, has fostered increased attention to its shallow water use. The system will operate in water depths of 50 to 20,000 feet. In water depths less than about 600 feet, the gun assembly (anchor launching system) is recoverable and reuseable.

Total cost of expendables is less than $1,400. They provide between 20 and 60,000 pounds of long term holding capacity. This capacity is predictable and depends upon seafloor characteristics.

Basically made up of a gun assembly and a fluke assembly, the 20K anchor is seven to nine feet tall, depending on the type of fluke attached. Two types of fluke are used: plate-like for sediment (1½'x3' for sand and 2½'x5' for clay); and arrowhead-shaped for rock (3 feet long).

Total system weight varies from 1,800 to 2,000 pounds, with 300-500 pounds of fluke assembly. Present use requires controlled lowering of the system until seafloor contact initiates firing. The fluke assembly, with downhaul cable attached, is then propelled at speeds up to 440 ft per sec to depths of 60 feet in soft clay.

An upward pull on the downhaul cable causes the sediment anchor fluke to rotate from a vertical to a horizontal position and the rock fluke simply to wedge itself in the seafloor.

In a recent amphibious operation, the anchor was used in a sand seafloor. Two anchors were placed and remain installed in spite of repeated attempts to pull them out. Even the pull of a Navy warping tug did not cause failure (pullout) of the anchors.

To date the anchor has operated successfully in water depths of 47 to 18,600 feet and in seafloors from soft clay to hard rock. In basalt it held 107,000 pounds in direct uplift. In clay at 12,000 feet it held 48,000 pounds, more than a conventional anchor weighing four times as much and having twice as much line.

In silt and sand the anchor has exceeded line breaking strength at 60,000 pounds. Testing continues to further define performance in deep sea sediments.

The CEL 100K anchor is a system consisting of a large bottom-sitting launch vehicle, an anchor projectile and associated load line, connectors and firing control devices. The launch vehicle measures eight feet by eight feet at the base and is 13 feet high. When the system is rigged and ready for firing, all associated parts fit within these dimensions, except for the lines flaked around posts on the base of the launch vehicle.

In this condition, the total system weight in air is almost 15,000 pounds, including the weight of the launch of about 12,000 pounds. The anchor projectile, firing piston, lines, and miscellaneous small items account for the remaining 3,000 pounds.

The system is designed to operate in 20 to 500 feet of water although the range could be extended considerably with minimal modification. Also, the launch vehicle could be reconfigured along the lines of the CEL 20K propellant anchor to provide deep water touchdown firing capability.

Normally, 12 to 16 pounds of smokeless propellant are used, producing a peak gun barrel pressure up to 35,000 psi and a peak launching force up to 2.8 million pounds. This causes the projectile and piston (weighing 1,500 to 2,000 pounds) to accelerate downward, sustaining a peak acceleration of 1,800 Gs and achieving a maximum velocity of 350-400 feet per second.

Before an anchor implant, the system is prepared by muzzle-loading and securing the firing piston and anchor projectile, flaking the anchor load line and piston retrieval lines on the base of the launch vehicle for rapid payout, breech-loading the propellant, and securing the safe-and-arm device in the breech.

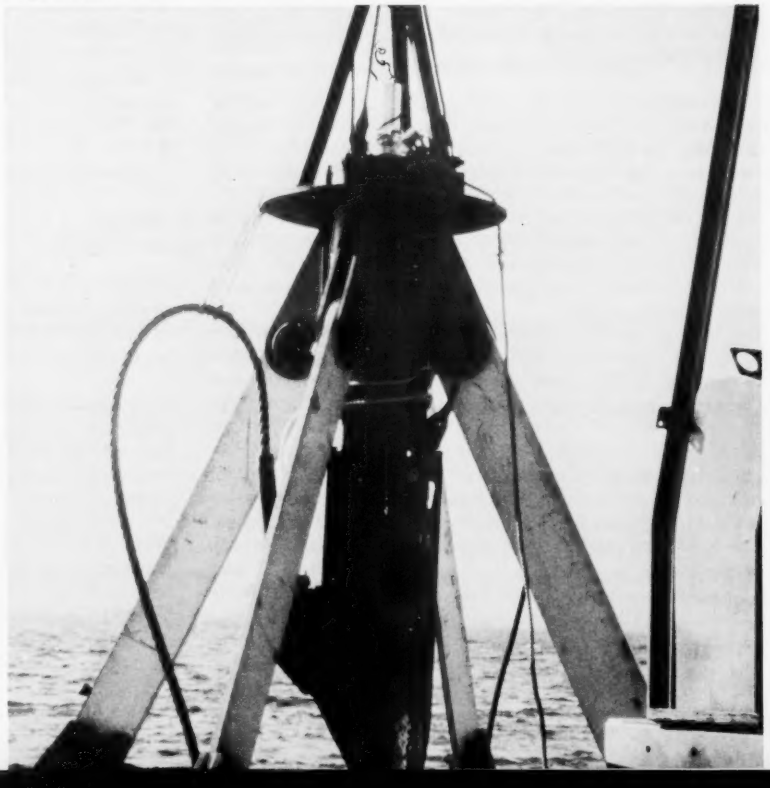
The system is then lowered by crane or separate line to the seafloor. When proper positioning on the seafloor is verified, the system is fired and the projectile driven into the seafloor. The launch vehicle, piston, and safe-and-arm device are retrieved for reuse.

This anchor is the current version of a large propellant anchor developed by CEL under contract for NAVSEA. Early development conducted under contract during 1966-68 yielded an anchor capable of holding up to 150,000 pounds in coral but only about 50,000 pounds in unconsolidated sediments.

Additional work was done at CEL between 1969 and 1974 to develop a less costly launch vehicle which is easier to transport and deploy than the early version. Also during this time, a larger version of the successful CEL 20K sediment projectile had been adapted to the 100K anchor. With this type of projectile, the anchor was tested to more than 230,000 pounds last year.

Recently this system was chosen to secure moorings for tankers in Diego Garcia where the remoteness of the site and the coral seafloor made conventional alternatives unsuitable.

The CEL developed 100K propellant anchor was used to provide mooring facilities near Diego Garcia Island.



for an additional lift

BALLOONS

may be the answer

The Navy, during World War II, operated the largest fleet of lighter-than-air (LTA) craft ever assembled. These craft performed valuable anti-submarine patrols among other functions but as the costs for operation and maintenance increased, and with conventional aircraft's increased capabilities, LTAs became too expensive. There is talk now of once again using lighter-than-air craft in many civilian and military uses and one of the most unusual, but apparently most practical, is use of tethered balloons for movement of containers from ship-to-shore in undeveloped areas.

A tethered balloon tramway system, as currently visualized, would consist of a double drum winch or two single drum winches capable of tandem operation. These would provide back and forth movement for the balloon, as well as vertical control. Another winch could be used to move the line laterally for precise placement—such as over a containership cell.

The idea is not new—the west coast logging industry has used balloons to bring logs off slopes for ten years, and it was their balloon system which was borrowed to run simulated tests, sponsored by Advanced Research Project Agency (ARPA) in Oregon during March of 1973. Using a 530,000 cubic foot balloon and their double drum winch, along with a bulldozer as the lateral movement device, a simulated container cell was set up with a landing area 1500 feet away.

Communication with the landing area was maintained by radio, and cycle times—that time needed to place the strongback into the cell, attach it; and move the container 1500 feet; detach and return the strongback to the cell again—were comparable to times achieved in offshore exercises using cranes on-board ships or platforms.

Tests were sufficiently successful to prompt planning of an additional exercise in FY76 in the Norfolk area and both the Army and Marine Corps have indicated interest in the system.

Usually, when first hearing about a tethered balloon system used in an advanced military area, there are a number of questions which immediately come to mind. For example, the first question always asked concerns balloon vulnerability. Actually, these balloons are relatively invulnerable, primarily because of the low differential pressure across the skin.

When a projectile passes through the balloon, it makes a small hole in both sides which partially closes after passage and, since the pressure difference is so small, relatively little gas escapes. A balloon capable of lifting 20 tons would be 150 feet across, and could sustain literally thousands of holes before losing significant lift!

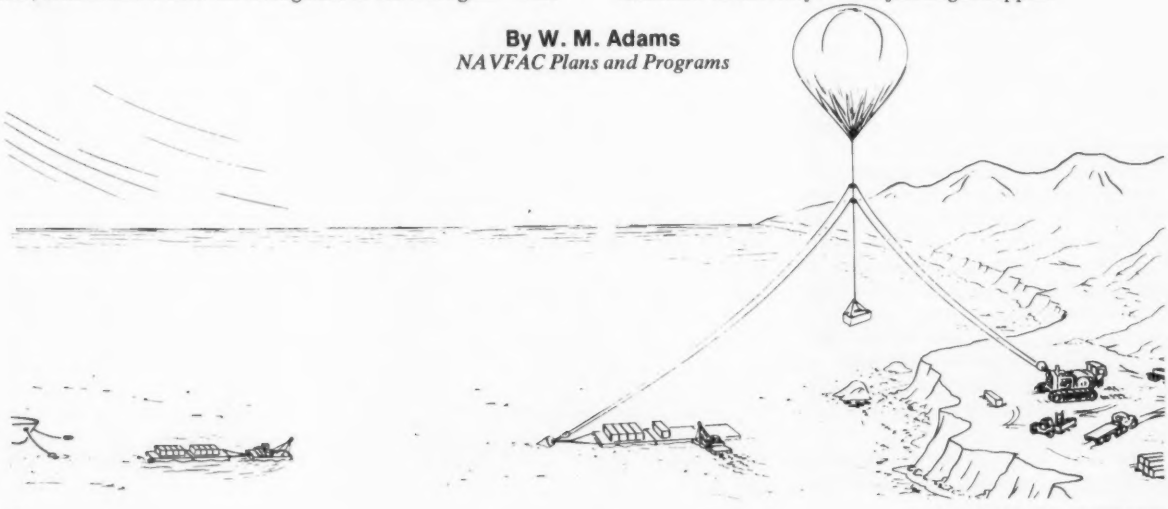
Other questions address delivery and set up of the system, compatibility with ships, mobility, alternate uses, reliability, and maintenance and operational considerations.

Under joint Army-Navy sponsorship, the Air Force's Range Measurement Laboratory at Patrick Air Force Base—a group with considerable balloon experience—conducted an engineering study of these questions and proposed a number of interesting alternatives.

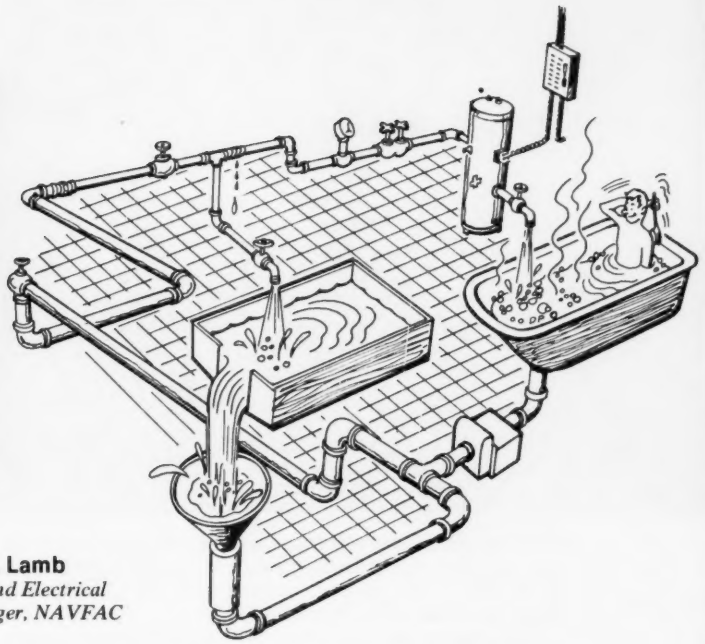
In short, it appears the system offers a viable alternative to conventional container offloading techniques, and hopefully the FY76 tests will warrant purchase of a full size system in FY77 or 78.

Balloons? In the Navy? . . . It just might happen!

By W. M. Adams
NAVFAC Plans and Programs



toward better utility services



By H. C. Lamb
Mechanical and Electrical
Program Manager, NAVFAC

NAVFAC sponsors an active R&D program at CEL to improve utilities at shore facilities through better materials, equipment, testing methods, and techniques. This has become an increasingly important area in light of high costs associated with furnishing and maintaining utilities today.

Recent efforts have included investigations of underground pipe lines, underground electrical distribution lines, electrical equipment and hospital electrical systems.

Use of reinforced plastic pipe as a substitute for conventional metal piping for buried aviation fuel distribution was also investigated. Commercially available systems for inservice inspection of pipelines were evaluated and one system was found applicable for Navy use to determine the condition of steel pipe.

An important feature of the system is its ability to detect corrosion pitting before leaks occur. A device for reducing the electrostatic charge in flowing hydrocarbon fuels has been tested and evaluated to determine its performance and limitations in reducing this hazard in fuel handling operations.

With the trend to more underground electrical distribution systems there is an increasing availability of better techniques for improved splicing and connections. Several types of shrinkable tubing and vulcanized splice covers have been tested for use with 600-volt cables. Some splice covers were found to provide effective and economical protection for Navy use.

Multi-tap feeder connectors were found to be cost effective and generally were superior to hand splices. Current methods and materials used in splicing and termination of high voltage underground cable are now being investigated and recommendations for these will be developed.

Acceptance and maintenance testing techniques and fault location devices for underground high voltage electric cables are being investigated. The present method of maintenance testing (high potential) is inconvenient, expensive and often unreliable. The feasibility of an alternate method of monitoring cable leakage current with built-in sensors while the cable is operating at normal voltages and currents is being studied. The practicability of the new concept under field conditions will be determined and the effectiveness compared to existing techniques.

A recent study confirmed that current medical procedures, coupled with the ever increasing use of electronic equipment, present electrical hazards unique to hospitals. This hazard, which can result in electrocution of electrically susceptible patients from extremely small currents and voltages, is known as microshock. An investigation of the problem resulted in an explanation of the hazards and recommendations of how to alleviate the hazards in both new and existing hospitals.

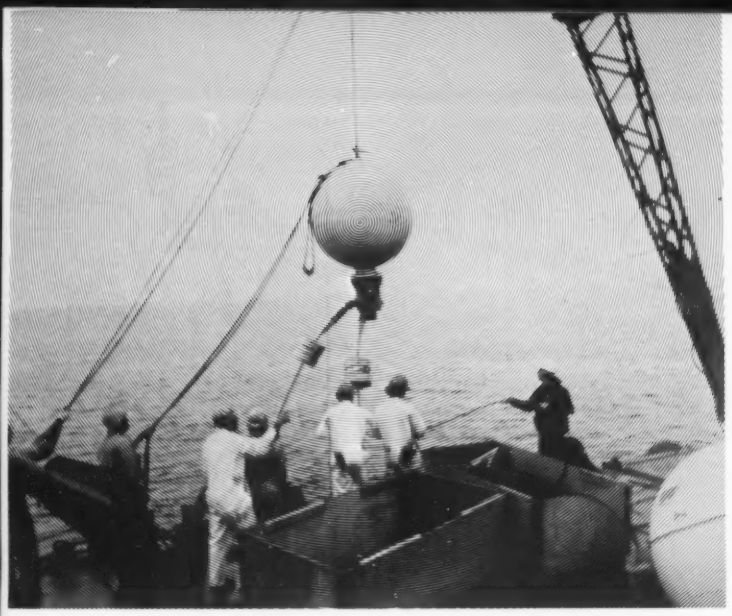
Other possible hazards in hospitals are associated with electric diagnostic and monitoring equipment due to electromagnetic interference. The nature of the electromagnetic compatibility problem was studied and recommendations to help solve the problems for new hospital design and for retrofitting existing hospitals have been made.

Shore-to-ship electric power cable problems are now being given extensive attention in the R&D program. Materials are being investigated for repairing and splicing the flexible three-conductor cables. Test methods and instrumentation are being developed for performing pre-service and in-service tests on shore-to-ship cables to detect electrical hazards as well as impending electrical failure of the cable. A study is underway to determine the feasibility of developing an aluminum conductor cable as a substitute for copper conductor shore-to-ship cable to reduce weight and cost.

Operational problems have been encountered with molded case circuit breakers used for shore-to-ship electrical service. A test program showed that in the imposed salt-fog environment, the molded case circuit breakers were more susceptable to corrosion failure than low voltage power breakers. Further tests indicated solid-state trip circuit breakers are superior to electromechanical molded-case circuit breakers for installations with high ambient temperatures but are more vulnerable to a heavy salt-laden environment. Results of these tests will be of assistance in choosing the best type of equipment for a particular application.

Corrosion problems are not being overlooked. Protective coating and new materials for underpier utility lines are being tested. Another area involves the long term effect of protective coatings on the thermal performance and material deterioration of finned-tube air-cooled heat exchangers. Tests will directly compare the long term efficiency of coated versus uncoated heat exchanges as well as extension of useful life.

These are examples of some of the ways R&D can develop technology which will contribute to improvements in Navy utilities.



SEACON II
. . . and from the ocean floor . . .

By T. R. Kretschmer
SEACON Project Manager

A three-legged cable structure, one-half mile high and more than a mile wide, has been successfully installed in the Santa Monica Basin off Southern California by the Civil Engineering Laboratory (CEL), Port Hueneme, Calif.

This experimental structure, SEACON II, was built to gather data for evaluating cable structure design techniques.

During recent years, many analytical models have been proposed to analyze the behavior of moored cable structures. These models attempt to predict tensions in the cables and the geometry of moorings acted upon by changing ocean currents. Experimental data to evaluate the accuracy of models and determine the most reliable design for undersea cable structures is sparse.

The SEACON II structure consists of a triangular-shaped cable structure tethered 500 feet below the ocean surface by three 4,000-foot long mooring legs. A 5½-foot diameter steel sphere supports each corner of the triangle which is 1,000 feet on a side. The cables which form the structure are "torque balanced," designed to ease the job of deploying the cables from a ship at sea. Some cables contain electrical conductors to permit power transmission and electrical signals between distant points on the structure.

Anchors which secure two of the legs to the seafloor are deep water explosive embedment anchors being developed under a separate experimental program at CEL. Experience gained with the anchors in SEACON II will increase confidence in their long-term anchoring ability. Also, engineers can gain experience in installing anchors in a quasi-operational situation.

Three of the anchors were successfully installed during a single work-day at sea (a third explosive embedment anchor is being used to secure a single point construction moor at the site). An 8-ton dead weight clump anchor is used to moor the third leg of the structure. This clump anchor doubles as a container for a radiosotope power generator (RPG) which continuously supplies ten watts of power to operate instruments on the structure.

An acoustic positioning system is the main source of data on structure response to changing ocean currents at the construction site. This system consists of acoustic projectors (sound sources) accurately positioned on the seafloor and hydrophones (listening stations) at key locations on the structure. Signals are sent between the projectors and hydrophones every half hour to monitor the changing shape of the structure.

The system is designed to detect a position change as small as one foot. Sensors for measuring cable tensions and water depths at key locations complete the structure response measurement system. All sensors are controlled and data are recorded on magnetic tape by an electronics package located in a buoy 60 feet below the surface. This instrument package is accessible to SCUBA divers so it can be easily serviced. CEL's Diving Locker personnel aboard their converted LCM-8 boat support cruises to the site to service the subsurface electronics.

A current measurement system was installed to detect the magnitude and direction of the ocean currents which move the structure about. Three strings of current meters surround the structure to measure any variation of currents in the horizontal plane. A neutral float interacting with a local seafloor navigation system was developed to calibrate the current meters in place. The float is weighted to become neutrally buoyant at a desired depth. It is then allowed to float through the site at that depth while its position is continuously monitored. The velocity of the neutral float is then determined and compared with data obtained from the moored meters.

A distinguishing feature of the SEACON II operation was its eight-phase installation plan. This approach provided the flexibility needed to insure a successful implant. Each phase was designed to be completed in one day or less and equipment could be protected from bad weather if necessary at the end of each phase. Phases could be combined, however, for a more efficient operation, weather and equipment permitting.

A detailed operational plan, including step-by-step procedures for at-sea operations, was prepared. All installation personnel were thoroughly instructed in each phase of the operation. CEL riggers who manned the 135-foot implant barge received at-sea training on critical parts of the installation, using actual cables and real or realistic components of the structure.

Pre-implant training afforded the opportunity both to instruct personnel and to test installation techniques. The extensive planning and training paid off; the SEACON II structure was successfully installed during eight days at sea in August and early September, 1974.

Since completing the implant, much of CEL's effort has been spent in getting the complex instrument control and data processing-recording equipment properly tuned to record accurately structure performance data. This equipment is now operational and the data collection phase of the project has begun.

After eight months in the water, the structure continues to maintain nearly complete mechanical and electrical integrity. SEACON II represents a milestone in the Navy's efforts to develop the capability to design and construct large and complex undersea cable structures.

New Shelter Designs For The U S M C

By M. R. Herrmann
Civil and Cold Regions
Program Manager, NAVFAC

In February, 1972, the Marine Corps Development and Education Command completed a study to determine shelter requirements for all Fleet Marine Force air and ground units, and to develop a concept to satisfy these requirements.

A large volume of data was collected, validated, catalogued, and a concept formed. The concept consisted of a family of seven durable, austere shelters and a lightweight, versatile logistics trailer to transport the shelters.

Small shelters — Four modular structures make up the inventory of small shelters. They are: an eight-foot by eight-foot by twenty-foot rigid structure, a knockdown structure which sets up into an eight-foot by eight-foot by twenty-foot shelter, and an eight-foot by eight-foot by ten-foot, and an eight-foot by eight-foot by twenty-foot rigid structure shielded from electromagnetic interference.

Large shelters — Three peaked roof type structures having nominal floor areas of 20 feet by 32 feet, 32 feet by 72 feet, and 60 feet by 120 feet make up the inventory of large shelters. The structures are fabricated in eight foot wide bays which fold for storage and transport.

Logistics trailer — The transport vehicle for these shelters is a full trailer with a cargo capacity of 25,000 pounds and self load and unload capacity for container-type cargo loads of up to 12,500 pounds each. Minimum trailer bed dimensions are eight feet by twenty feet with the capability of being converted to a semi-trailer to transport cargoes of up to 50,000 pounds.

Chesapeake Division, NAVFAC, developed procurement documents for the purchase of shelters, logistics trailers, and associated items. Contracts were awarded to Northrop Corp., (Electronics Division) of Hawthorne, Calif. Northrop selected three firms as sub-contractors for hardware item design and prototype fabrication during subsequent development efforts: Pascoe Steel Corp. for the large shelters, Atco Limited for the small shelters, and Ameron Corp. for the logistics trailer.

The effort to date, plus limited field tests by service personnel, indicate the concept can replace 75 types of shelters now in the Marine inventory. Further, the standard family approach is to meet requirements of the International Organization of Standards for containers.

Standard dimensions unify handling and transportation equipment and made the items compatible with land, sea, and air transportation modes.

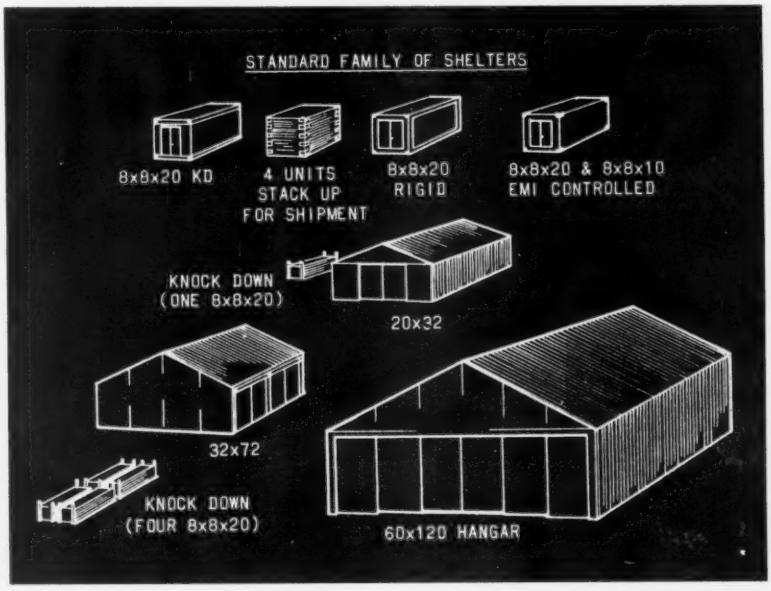
The program is now in a justification and decision making phase concerning advanced development and follow-on research and engineering efforts. The Navy Material Command in May, 1974, designated the Naval Facilities Engineering Command as principal development activity for the Marine Corps expeditionary shelter system.

NAVFAC is to undertake management and technical responsibility for execution of the development effort, including timely budgeting for and allocation of resources within the approved plan.

A development proposal has been prepared by the Civil Engineering Laboratory and, at this writing, the proposal is being staffed through Marine Corps Headquarters. Also, a preliminary integrated logistics support plan was prepared by the Civil Engineering Laboratory and is expected to be published this summer. These documents and supporting testimony will be used by the Marine Corps Systems Acquisition Review Council to determine the future of the program. The council planned to meet this summer and take action on the plan extending through FY85 at an estimated cost of $75 million.

It should be emphasized the original concept was formulated by the Marines and "green" dollars have supported the effort to date and will fund future work. Marine Corps Headquarters and the Marine Corps Development and Education Command are responsible for many phases of the program.

It is believed program results will satisfy most of the Marine Corps shelter requirements as well as satisfy some shelter requirements of the other services. Procurement of fewer types of shelters should be more economical than purchasing the many types of shelters now in the Marine Corps inventory.



SOLID WASTE

A valuable "misplaced resource"

By S. M. Hurley
Manager, NAVFAC
Environmental Protection Program

The size and changing complexity of the military often leads to rapid accumulation of solid waste requiring ever more attention to minimize disruption of military operations. This growing problem, with its unique and variable demands on manpower and equipment, coupled with manpower reductions and new disposal limitations, is consuming a disproportionate share of the military's primary mission resources.

These operational problems, taken in light of energy shortages and rising material costs, give strong impetus to the concept that solid waste is a misplaced resource.

Recovery potential of this value as an offset to growing operational costs is providing new direction for military solid waste research and management practices.

How big is the problem

The principal concerns of DOD in solid waste management are the variable demand and rising cost for handling and disposal of wastes; and the need for more cost-effective pollution abatement methods. From FY66 through FY70 reported property maintenance expenditures increased at approximately 5 percent per year while reported expenditures for refuse and garbage disposal increased at approximately 8 percent.

Costs reported for refuse and garbage disposal do not accurately reflect DOD solid waste management spending. To arrive at a more realistic assessment of the economic impact of solid waste it is necessary to add a portion for custodial service costs, a fraction for vehicle operation and maintenance, and a prorated share of undistributed overhead and administration costs. At an annual growth rate of 6 percent, a conservative projection of DOD solid waste management costs is as follows:

Millions of Dollars			
FY70	FY75	FY80	FY85
75	100	135	180

The trend towards higher solid waste management costs is expected to continue at least at the current rate. Factors contributing to an even higher rate of increase are the critical requirement for manpower and equipment to meet frequent peak demands in existing solid waste management practices, the labor intensive nature of current solid waste practices combined with demands for higher pay, the increased action of regulatory authorities and courts in environmental concerns, and increased fuel costs and longer hauls to disposal sites.

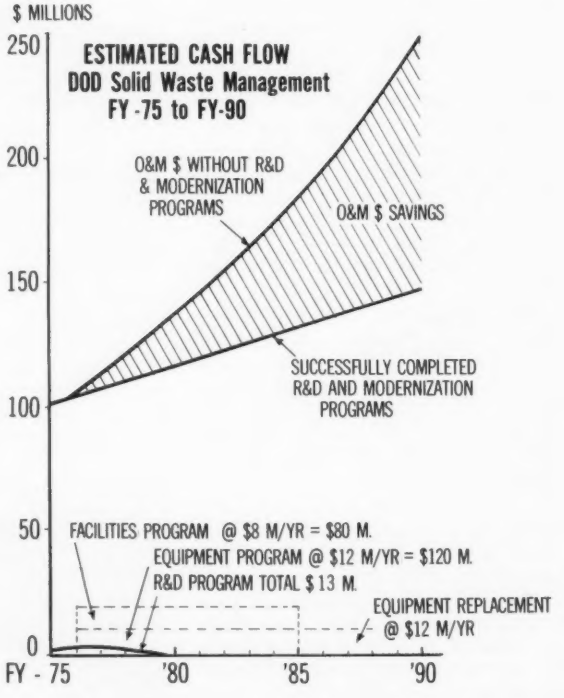
Solid wastes must be collected and disposed of quickly to prevent health hazards. Faced with costs rising faster than available funds, military public works managers, of necessity, defer other maintenance spending to meet rising utility and variable solid waste management demands.

These trends are expected to continue with solid waste management taking up an increasing share of funds and manpower available for real property maintenance and, finally, fleet operations.

R&D tasks

Area Coordinating Paper No. 42, Environmental Quality, issued by the Director of Defense Research and Engineering (DDR&E) sets priorities for research and development in the DOD pollution abatement effort. In general, priority is given to operational capability, developing pollution control technology for DOD activities, and solving pollution abatement problems quickly and economically.

These priorities have been followed in development of this proposed solid waste research plan. The plan provides for a timely flow of qualified systems technology to provide cost-effective alternatives to the problems. The objectives of the plan are as follows:



Primary

- Reduce 1985 solid waste handling and disposal by 25 percent ($45 million/year).
- Reclaim the energy and resource value of solid waste.

Secondary

- Develop equipment and techniques consistent with skills, manpower, and resources available in DOD operations.
- Provide criteria for standardization of military practices in solid wastes.
- Reduce the labor intensiveness of solid waste operations.
- Extend the life of military sanitary landfills.
- Increase reuse of waste materials.
- Develop non-polluting disposal methods for non-recoverable residual wastes.

Resource (cont.)

Tasks in the planned program adhere to established policy guidelines to be used in evaluating and controlling task performance and for instituting new tasks. These guidelines require that each RDT&E task must:

- Qualify all available technological developments that can be temporarily or permanently utilized to benefit military solid waste operations.
- Reflect close inter-service coordination and joint utilization of systems, equipment and facilities in areas of common development.
- Provide recognition of the potential for inter-service utilization of each product.
- Provide for costs and performance information that support military solid waste management personnel in equipment selection and operating procedures.

Since solid waste RDT&E has been underway in a number of laboratories for the past few years, certain projects are nearing completion while others are in very preliminary phases or have not been started. Not all projects involve all phases of RDT&E from preliminary investigations through delivery of fully engineered and optimized hardware.

Some have omitted early phases because of earlier work. Other projects have omitted production models and end with design guidelines or specifications.

Cost benefits

Realization of the benefits of the military's RDT&E program for solid waste management will require associated military construction and equipment procurement programs.

The direct economic benefit or return on the investment in R&D comes from annual cost saving in solid waste operations and maintenance. Other benefits not included in this analysis are:

- Recovery of the energy value of solid wastes.
- Recovery of materials currently placed in landfills or salvage and resale.
- Increased availability of sanitary landfills and other options for disposal of residual wastes.
- Eliminate costs due to deferred real property maintenance.
- Reduction in unidentifiable utility, manpower and equipment costs being diverted to solid waste management to cover special problems.
- Timely compliance with local pollution control agencies and better community relations.
- Faster and more effective solid waste management decision information.

Conclusions

The $13 million R&D cost planned in this program represents less than 2 percent of the $700 million DOD will spend on solid waste handling and disposal over the six year life of the effort. This is considered a reasonable return on an R&D investment.

The R&D plan includes the cost and procedures to monitor overall progress toward a goal of 25 percent reduction of O&M costs by FY85. Trends that indicate misdirection in achieving this goal will be evaluated for early program reassessment. This regulating aspect, with a measurable standard for success, will insure continued critical review of progress and provide for program needs, effectiveness and economy.

"...from ship to shore."

By Richard C. Towne
Senior Civil Engineer

An elevated causeway, a new capability permitting amphibious operators to move 20-ton container-sized loads from ship to shore, is being assembled by the Civil Engineering Laboratory (CEL), Port Hueneme.

Associated hardware is composed mainly of existing Navy assets modified as necessary or provided with modular add-on components. For example, the existing NL pontoon system, operated by Amphibious Construction Battalions, remains the basic unit with modular internal or external spudwells provided to adapt to a hydraulic jack lift system and steel support piling.

Internal spudwells have outside dimensions similar to a P-1 pontoon, five-feet by seven-feet by five-feet deep, and during barge assembly they are positioned instead of pontoons. External spudwells may be bolted to exterior angles of existing causeway sections, adding versatility to the equipment. The 20-inch diameter steel piling and spudwells will withstand the forces of a 15 to 20 foot wave on the piling. The piling may be cut flush with the deck if desired to provide a clear working area after elevating and welding.

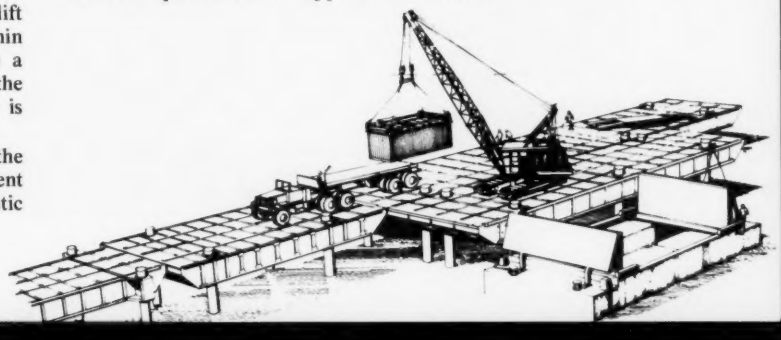
The hydraulic jacks were designed and built under contract and preliminary tests at CEL have proven the system can lift a barge in surf conditions. Barge lifts of 200 tons are within the system's capabilities. It takes 30 minutes to elevate a pontoon section using the hydraulic jacks, positioning the section bottom 10 to 15 feet above the surf. More time is needed to position and drive piling.

Once elevated, a fender system is installed to protect the piling and adjacent lighterage. Again, the basic equipment is the standard NL pontoon gear with commercial plastic fenders added to the outboard side. The fender system has two pontoon strings (seven-feet-wide and 180-feet-long) and high energy absorption fenders four feet in diameter and ten feet long. Additional piling is driven to support the fender.

During elevation, the causeway sections may be adjusted to provide a two-to three-foot difference in elevation between the opposite ends of each section, allowing a tolerance to meet varying beach ground heights.

After the causeway has been elevated, a 90-ton capacity container-handling crane will traverse the pier and position itself to lift containers from lighters. A truck-trailer will drive to the crane area, be rotated by a turntable, and loaded with a container directly from the crane. The turntable will be placed on a single section of causeway. It does not need a pierhead or additional width.

Truck-trailer container handling from the elevated pier allows rapid movement from the beach to inland distribution sites. Container loads of 12 to 20 tons can be transferred in unit lifts, compared to lifts of only 800 to 2,000 pound pallet loads. Containers provide temporary covered storage convenience and quick access to supplies when needed.



ADVANCED BASE

Delivery and Storage of

By K. Hankerson
NAVFAC Plans and Programs

Traditionally, providing bulk fuel to assault troops ashore has posed difficult problems. Today, circumstances are converging to make such support marginal or infeasible. Since a modern landing force is totally dependent on adequate and timely fuel delivery, solution of the problem calls for early corrective action.

Circumstances making the bulk fuel problem more serious stem from the non-existence of gasoline tankers (AOG class ships) and rapidly diminishing numbers of small commercial shallow draft tankers. In past operations, it has been possible to divert enough AOGs to supply the Marines' Amphibious Fuel System (AAFS) ashore.

However, aging AOGs have been retired without replacement and the number of small commercial tankers is decreasing in favor of the newer handy-size tankers displacing 25,000 to 70,000 DWT. These deliver over 9 million gallons of POL.

Since the Marine Corps will only maintain some 6 million gallons of fuel storage ashore and with over 9 million gallons of POL aboard a handy-size tanker, it is apparent alternate storage facilities must be used or the tanker will remain on station for extended times. This is neither tactically nor economically practical.

Early in an operation, existing amphibious ships which discharge through the standard 5,000 foot floating pipeline system, will be able to handle landing force requirements. However, for sustained operations, a capability is needed to moor and discharge large commercial tankers with deeper drafts.

This article will address various sub-systems of a POL delivery and storage system planned to meet these needs.

Mooring sub-systems

A rapidly increasing number of handy-size or large tankers means an increasing number of ships drawing 32 feet or more and displacing up to 100,000 DWT. This contrasts sharply with the Patapsco Class AOG which draws about 16 feet and displaces less than 4,600 tons.

The greater the draft, the further from shore the ship must be moored to prevent grounding. Present Navy pipelines extend 5,000 feet. Larger ships will need some 10,000 feet of pipeline.

Larger ships also require different moorings. Where a standard fleet moor will hold an AOG or small tanker, a single buoy mooring (SBM) is the normal mooring expected for handy-size and larger tankers.

To give maximum stability to this type of mooring (SBM), at least six to eight legs (anchors) are laid out. These legs will be installed with propellant embedment anchors and synthetic fiber lines.

Adoption of the SBM system into the Amphibious Construction Battalion table of allowance will reduce the amount (cube and weight) of equipment from the previously used spread moor system with chain and conventional anchors.

The present six inch floating and bottom-laid pipeline systems are adequate, as presently designed, with some improvements and auxiliary equipment. As stated, the trend is to moor larger tankers in deeper water further from shore.

To retain 600 gallons per minute pumping rate with a six inch line, it appears a booster pump needs to be developed for distances longer than the current 5,000 foot lines.

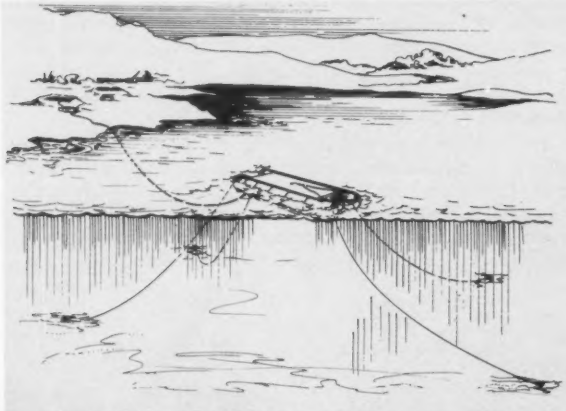
This booster station could be mounted on a floating platform or it could be submerged. Each of these configurations has certain advantages. An in-depth investigation will determine the feasibility and comparative costs of each.

Storage sub-systems

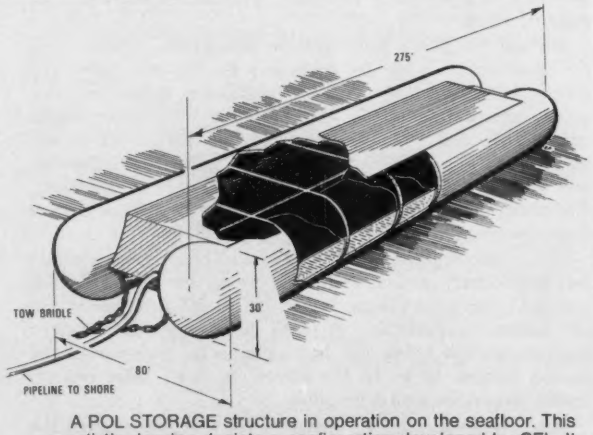
Future R & D planning must consider additional storage capacity both on-shore and off-shore to minimize tanker turn-around time.

A number of alternatives have been investigated in the past for storage of POL at sea during assault operations. These have included Sea Cache (concrete tanks floated to the site, sunk, and used for storage), Dracones (floating collaspible fuel bladders), and commercial LASH barges with bladders for POL storage. A review of the alternatives will be made and the most promising system will be tested.

Recognizing that bladder type storage is not adequate for long durations and current bolted steel tanks are difficult to build and maintain, a number of alternatives for on-shore fuel storage will be investigated, such as roll-up welded tanks and field fabricated fiber glass tanks.



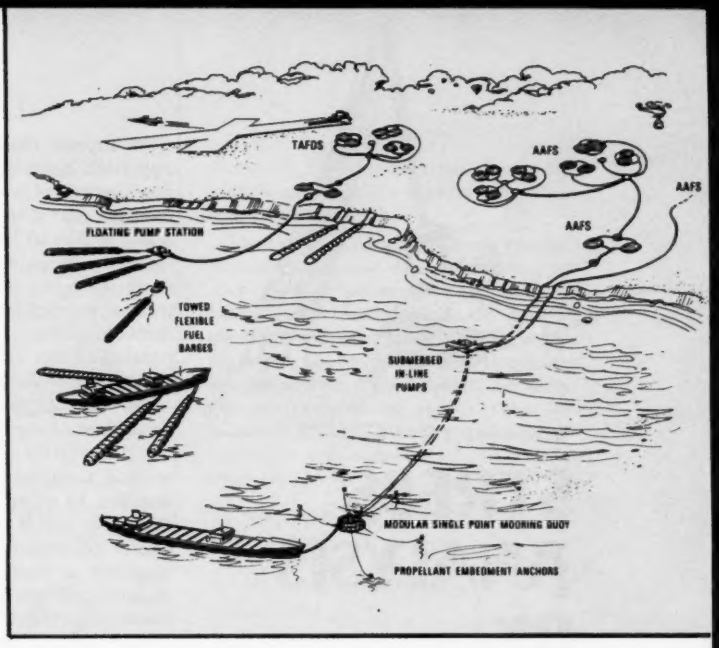
POL STORAGE STRUCTURE in operation at the surface of the sea. Storage capacity is two million gallons. Each structure will be fully equipped to receive and discharge POL through a single point moor offloading system.



A POL STORAGE structure in operation on the seafloor. This artist's drawing depicts a configuration developed by CEL. It consists of two compartmented cylindrical tanks connected by bottom and top decks.

POL

By Norman D. Albertsen
Senior Research Civil Engineer



One primary U.S. Navy mission is logistical support of armed forces at advanced bases and during amphibious operations. An essential part of this mission is supply of POL (petroleum, oil, lubricants) to forces ashore.

Recent changes in the character of our POL tanker fleet (the average size commercial tanker has increased by several times in the last decade) combined with the loss of foreign bases and strategic doctrines that emphasize force mobility, make successful fulfillment of the POL logistics mission very difficult.

In future operations, a few large tankers (25,000 to 70,000 DWT) will accomplish the POL transport mission carried out in the past by many small tankers of 2,000 or 5,000 DWT. It is neither tactically nor economically feasible for large tankers to remain on station as floating storage or to require them to replenish limited on-land storage facilities of less than 5 million gallons capacity very three to five days.

Rather, units charged with distribution of POL must now provide large volume storage facilities of 10 to 20 million gallons capacity to carry them through 10 to 20 days until a large tanker can return.

Large volume on-land storage facilities are costly and time consuming to erect, require a large land area for dispersion and safety, are relatively vulnerable to attack, and are not compatible with mobile force doctrines. It is therefore vital that an offshore POL storage capability be developed where high capacity, security and mobility can be retained.

One of the most promising ways to achieve high storage capacity, improved security, and system mobility is to store POL in towable structures which can operate from the seafloor. The Civil Engineering Laboratory (CEL) has, for the past three years examined the problems of submersible POL storage systems and has found they can be developed by straight-forward application or refinement of existing technology.

A tentative storage structure configuration, developed by CEL, consists of two compartmented cylindrical tanks connected by bottom and top decks. The center section enclosed by the decks is sized to have a volume equal to one of the cylindrical tanks and is used as part of the internal seawater ballast system which allows quick deployment of the structure to the seafloor.

The structure is made of prestressed concrete because of its excellent strength and durability. Also, the submerged weight of concrete eliminates the need to anchor structures to the seafloor under most conditions. In addition, the material allows direct scaling of the basic configuration from small structures of 65,000 gallon capacity — which can be transported aboard LASH (Lighter-Aboard-Ship) vessels — to large structures of up to five-million gallons capacity designed for open-sea towing over intercontinental distances.

Large versions of the CEL concept would be towed to site, ballasted to negative buoyancy using an internal seawater ballast system, and quickly deployed to the seafloor at depths to 600 feet. The tow line is used as the lowering line. An alternative, when there is little danger from adverse weather or enemy action, has the structures moored on the surface.

Each structure would be equipped to receive and discharge POL on the surface or on the seafloor through a single point moor offloading system. Several structures could be assembled offshore to provide any needed storage capacity. Five structures of two-million gallons capacity each would be sufficient to handle the entire cargo of a "handy size" 25,000 DWT tanker. This is enough POL to support a Marine Amphibious Force (MAF) for 10 days.

As storage requirements change, the structures would be deballasted, retrieved and redeployed to reflect those changes.

The concept has been configured to store large volumes of POL offshore to support amphibious operations or advanced bases. However, the concept has alternate uses. For example, it could be used to help alleviate occasional POL storage shortages in our Peacetime Operating Stocks (POS) used in day-to-day operations and our Prepositioned War Reserve Stocks (PWRS) for use during hostilities.

In addition to POL storage, the concept could be configured for storage of other liquids, such as fresh water, or for packaged and bulk items such as ammunition and food stuffs.

Preliminary studies indicate that while the seafloor storage concept is within the current state of the art, some development work will be required to refine the concept. Areas needing detailed study are: transport to site-structure shape, transport mode (surface, submerged, etc.) and the availability of vessels to enhance, to the greatest extent possible, transportability.

Deployment-retrieval, refinements in deployment and retrieval techniques, along with an investigation of the type and arrangement of POL and ballast-handling equipment, must be studied in detail to ensure operational requirements (rapid set-up, appropriate POL transfer rates, etc.) are achieved.

Survivability-the resistance to environmental hazards (storms, seafloor conditions, etc.) and hostile enemy action-must be studied for consideration in final system design.

These technology studies can use much existing technology developed by the offshore oil industry and others. Analytical and experimental studies will be required to develop data where existing information is lacking.

Parameters which adversely affect military POL logistics (tanker size, loss of foreign bases, mobility requirements, etc.) have, in combination, produced a situation where new concepts for the storage and supply of POL must be considered.

The CEL concept is one possible approach to maintaining the flow of POL to our forces when and where needed worldwide.

STRESS ANALYSIS BY COMPUTER

By John E. Crawford
Senior Research Structural Engineer

During the past 10 years, a series of complicated analytical techniques has become available for the structural design and analysis of naval facilities.

These techniques typically use computers to simulate the response of structural systems by numerically solving partial differential equations. The more complicated the simulation desired (e.g., the response of a shipping container dropped during handling) the more complicated the computer input becomes and the more difficult and time-consuming is interpretation of results.

For the past five years, the Civil Engineering Laboratory (CEL) has been developing software that not only reduces efforts related to input-output, but dramatically transforms the man-machine interface.

The key to improving man-machine interaction is proper assignment of functions; that is, computers assigned to number crunching and people assigned to thinking. But widespread application of computer simulation generally has had the opposite effect with people punching thousands of numbers and poring over hundreds of pages of output.

Often this produces erroneous results extremely difficult, even for specialists, to detect and evaluate. For the general engineer, where little time is available to develop data and ascertain its accuracy and appropriateness, this situation frequently denies him use of a valuable tool.

To improve these circumstances, the approach employed at CEL involves development of pre-and-post processing software that shields the user from the many pitfalls of large scale computing. However, following the "you can't get something for nothing" philosophy, these new schemes require more people thinking and sometimes produce other restrictions not inherent in the simulation programs themselves.

The primary technique at CEL for simulation of the structural response of naval facilities is the finite element method. Complex structural systems are modeled by using assemblages of substructures called finite elements. The degree of accuracy and detail of the analysis generally depends on the number of elements used and the material characterization chosen.

To model a complex structure, a significant number of elements of different types are required. Material simulation ranges from the simple linear parameters of steel (i.e., Young's modulus and Poisson's ratio) to the wide variety of complicated mathematical functions used to characterize such highly nonlinear materials as soils, ice, plastic flow of metals, and concrete cracking.

At CEL, simulations are performed for a variety of structures; dynamics, static, linear and nonlinear. Examples of these studies include response predictions for antenna systems, various containerized facilities, pile-supported causeways, buried structures subjected to nuclear attack, and the response of the human head structure to various kinds of impact.

Two examples provide the "flavor." The first explains how computer graphics are used to aid debugging data and presenting results. The second describes a technique which completely "masks the user from the finite element program."

The TACOSS and Marine Corps Shelter System are intended to provide rapidly deployable, cost-effective camp facilities for Naval Construction Forces and Marine Corps Engineer Support. The modules are fabricated from standard shipping containers.

Objectives of the structural analysis were to provide information about the static structural response of the module and to study the response of a module during emplacement by helicopter.

Static loadings are encountered in transit and the purpose of this simulation is to detect if modifications made to a standard container posed any limitations on its operational capability.

Preparation of data (input) entails dividing the "real" structure's walls into rectangular elements. Each element and its corners (nodes) are numbered. All the data is computed by a small program (preprocessor) and punched onto cards before running the finite element program. In addition, the input data is plotted automatically by another computer program called a postprocessor.

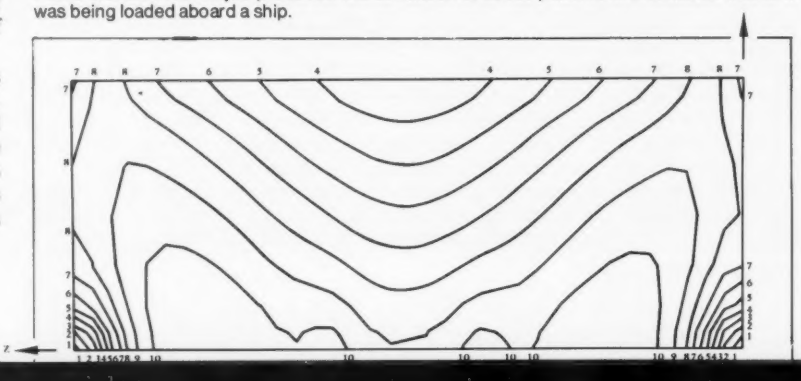
Our second example illustrates the nonlinear analysis of airfields loaded by multiwheel aircraft. Data is supplied in terms airfield engineers have traditionally used (layer thickness, plasticity index and void ratio for the soils).

This scheme completely masks the relationship between the user and the finite element process. Results are presented as response envelopes for stress-strain which can be related to the number of aircraft landings before pavement failure. This scheme involves so little data that unlike most finite element applications, it is readily operated from a teletype terminal which can be plugged into any phone.

Pre-and post-processing software is an integral part of computer based technology and to a certain extent is "the tail wagging the dog." The more complicated analysis techniques are practically unusable without some computer preparation of input and computer generation of summary tables and graphical displays. Parenthetically, techniques which are not amendable to pre and post processing cannot compete.

The finite element method readily accommodates such schemes. This will allow its use eventually to reach the practicing engineer where finite element will form the nucleus for future computer based designs of naval facilities.

Finite element technique produced this simulation of stress patterns in a container wall as it was being loaded aboard a ship.



"AUDIT?"

By HORACE E. HIGHSMITH
Financial Services Division
• Alexandria, Va.

Auditing, or more precisely, internal auditing in the Navy, is assigned to the Director of the Naval Audit Service, who also is the auditor general, a staff assistant for audit matters to the Comptroller of the Navy (Assistant Secretary of the Navy-Financial Management).

The Navy Audit Service is composed of a Headquarters, located in Falls Church, Va., and five Naval Area Audit Services. These regional offices are designated: Capital; Northeast; Southeast; Southwest; and Northwest. Each of these offices is headed by a Navy captain, who is designated director.

The mission of the Naval Audit Service is to administer and perform internal auditing throughout the Department of the Navy, by providing an independent, objective review and evaluation of the efficiency and effectiveness with which resources are being used. Audit effort is classified into several categories, a few of which are: periodic; continuous; service-wide; regional; interservice; special purpose audits; and the audit emphasis program.

Periodic audits are scheduled for accomplishment on a prescribed cyclical basis (generally one to five years) and are performed by mobile audit teams. The audits are usually comprehensive in scope and may include examination of all functional areas, such as timekeeping, civilian payroll, supply management, cost accounting, etc.

Continuous audits are activity audits performed on a continuing basis by the resident audit staff physically located at the site. The audit covers one or more areas to produce comprehensive audit coverage over a period of time. This type audit is generally limited to the larger or more complex activities.

Service-wide audits are review and evaluations at selected activities and organizational levels of identified or potential problems in specific programs and functions as they affect the Department of the Navy. These audits usually involve two or more regional offices.

Regional audits involve review and evaluation at selected activities and organizational levels and are similar to service-wide audits except that examination is limited to a designated geographic area.

Interservice audits are planned and coordinated by the Deputy Assistant Secretary of Defense (Audit), and performed on an integrated basis with other DOD units agencies to provide concurrent coverage of a problem, program or subject. Where Navy participation is required, responsibility for conduct of the audit is assigned to the most appropriate regional office. In these audits, no formal report by the region is prepared, but rather the results of audit are consolidated and the full audit report is issued by the Office of the Assistant Secretary of Defense (Comptroller).

Special purpose audits are those audits authorized by the Director, Naval Audit Service, in response to requests from naval or outside sources or those audits of less than 200 manhours of effort, when requested by a local command and authorized by the regional director. These audits are generally limited in scope to examination of a specific problem.

The *audit emphasis program* encompasses the review and evaluation of identified or potential problems. It concentrates examination on a preselected audit subject of senior naval management interest during regularly scheduled audits of activities. Subjects that are common to a wide range of activities, specific in nature, and narrow in scope are considered for audit emphasis.

Audit utilization begins at an early state in the audit program. Drafts of individual audit findings are provided to the supervisory personnel of the audited activity.

This provides command officials with the opportunity to discuss audit findings informally with the auditors and to provide the auditors with additional facts or background information.

After completion of on-site audit work, the auditors will assemble individual findings and recommendations into a draft report. This draft includes management position statements obtained during the audit.

The draft report will be submitted to the Command for completion of audit utilization. At this time, arrangements will be made for a closing utilization conference with the Commanding Officer. Concurrently with submission of the draft report to the activity under audit and other activities to whom a finding or recommendation is directed, a copy of the draft report is sent to the immediate supervisors in command (ISIC) of the activities for review and comment.

The required management position and planned action statements are furnished by the audited activity and the ISIC to the auditors within forty-five days after the draft report is presented to the local commander for audit utilization.

Within the NAVFAC family the responses of the immediate ISICs, such as PACDIV, LANTDIV, WESTDIV, NORTHDIV, are forwarded to Headquarters for preparation of the Headquarters response. The coordination of the Headquarters response is coordinated by NAVFAC Code 01, who on the basis of the report determines specific program involvement, and then distributes the report or items of the report to program managers for preparation of command position on both the findings and the activity and ISICs response to the findings and recommendations.

OCEAN ENGINEERING

By P. H. Cave
Seafloor Engineering Program Manager

The Navy mission is to maintain control of the seas vital to our National Defense. In looking to the future, which promises rapid advances in ocean science and deep ocean technology, the Navy mission must be viewed more broadly than in the past and there must be improvements in current capabilities and development of new capabilities so we can control sea bottom approaches to our shores, preserve our freedom to use the seas in war and in peace, and deny our enemies the use of strategic ocean volumes from which they could launch strikes against our cities.

NAVFAC has the assigned mission of planning, designing, constructing and maintaining fixed surface and subsurface ocean facilities in support of these Navy missions. Although it is most difficult to predict the exact form of these future ocean facilities, knowledge about construction of such facilities must be developed to permit logical designs and use of appropriate material and construction techniques as they are required. The goal of the NAVFAC Ocean Engineering R&D Program is to develop the technology for construction of the ocean facilities of the future.

The principal areas of ocean engineering R&D work currently sponsored by NAVFAC are: soil properties and foundations; construction equipment and techniques; and anchors and moorings.

Soil Properties and Foundations

Soil properties and foundations investigations are directed toward learning how to use ocean sediments as we do terrestrial soils. The effective installation and operation of facilities to support Navy missions requires securing structures to the seafloor. The structures involved may be moored by anchoring systems or may be supported directly by the bottom soils. For these applications, adequate knowledge of the engineering properties of these soils is required for the design of the anchor or support system. Determining the engineering properties of seafloor soils presents problems of much greater difficulty than for terrestrial soils due to the necessity for remote operation of sampling or testing devices and the near certainty of disturbance of soil samples from the action of the ocean floor.

Technology goes to sea

In general, seafloor soils behave in the same manner as do terrestrial soils. Consequently, existing knowledge of terrestrial soil mechanics forms the basis for understanding seafloor soils and for design of anchoring or supporting systems.

Seafloor soils, however, are often weaker and more compressible than comparable terrestrial soils and possess some unique properties due to deposition and presence in the marine environment. This requires the response of seafloor soils under various loading be studied and design methods be modified as required.

The R&D program is directed toward development of techniques for obtaining the required ocean soil engineering data in water depths to 20,000 feet and predicting the behavior of these soils under various long term and dynamic loadings.

Data acquisition work is underway on evaluating a variety of existing coring devices to determine, in terms of disturbance, the quality of samples obtained with different coring devices, developing techniques for improving the quality of cores obtained, and developing recommendations concerning the type of cores or in-situ test to achieve a specific accuracy in the quality of engineering data; conducting a number of in-situ and laboratory tests in deep ocean oozes, pelagic clays and turbidities to validate a previously developed disturbance correction factor for core sampling; and development of an expendable penetrometer to measure sediment areal uniformity.

This device, when used with coring and sub-bottom profiling data will provide information on sediment type variation cheaper and quicker than coring operations which require a ship be on station for long times.

In data analysis, laboratory model tests are being conducted to develop a procedure for predicting the long term holding capacity of embedment anchors. Dynamic tests are also being conducted on laboratory samples to determine the liquefaction potential of various deep ocean sediments.

Construction Equipment and Techniques

Underwater Construction Teams (UCT) are performing underwater construction and repair assignments for undersea surveillance activities, underwater test ranges and others. These assignments have identified the need for improved construction tools and techniques for performing underwater tasks at both diver and sub-diver depths. The existing tools and techniques, although adequate to produce the end results in some cases, require a large expenditure of manpower and funds to accomplish a given mission.

In response to these requirements, the R&D program in the area of construction equipment is presently directed toward development of construction tools for divers, and hardware and techniques for the installation and protection of submarine cables.

Examples of work in this area are: a diver-held hydraulic rock drill, four of which are now being procured for UCTs; a diver-held hydraulic band saw for cutting steel objects up to 3½ inches in diameter; a study that identified and evaluated alternate nearshore cable installation-immobilization concepts in terms of technical feasibility and cost; and a study to investigate methods and concepts for burying cable in the deep sea.

Analysis of existing and future missions indicates most facility support requirements will be met by buoyant installations, including ship moorings, which will require anchoring systems. Although work has been, and is being, done on anchorage systems, many deficiencies remain limiting design and use of cable systems underwater.

Anchors & Moorings

There is a need for more flexibility in the choice of anchors for holding a structure in a desired location. The projected increase in usage of fixed facilities in deep water, and the increasing complexity and reliability requirements of these facilities make it imperative that very reliable anchor systems be available. These systems must be efficient to install, and able to resist mooring forces from any direction.

Because of the critical role of cables in both implantment operations and providing stability to the structure, immediate attention must be given to understanding and predicting the behavior characteristics of cables, both mechanical and electromechanical; and their relation to specific service conditions. Also, as operations go deeper, the need for lightweight cable becomes very apparent because steel cables are heavy and make anchorage systems difficult to handle.

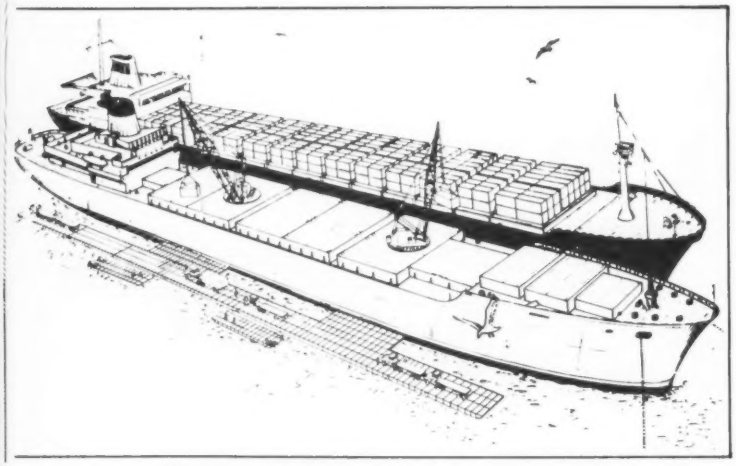
To improve NAVFAC's ability to handle these problems, the R&D program is directed toward developing new anchors, cables and analytical techniques to predict dynamic response of cable structures during implantment and in-situ. An explosive embedment anchor with a design operating depth of 20,000 feet and a design holding capability of 20,000 pounds has been developed and tested in various seafloor soils, including rock. Holding capacities generated by these test anchors have generally exceeded design capacity; however, additional testing is underway to expand the available data base and prove the effectiveness of the concept.

Lightweight cables are being developed for ocean engineering applications requiring cables or ropes with high strength to weight ratios. The program is focused on developing and testing cables of a new material called Kevlar. This material has strength member tensile strength around 300,000 psi with a specific gravity of 1.33. From results to date, this material looks very promising for cables.

The dynamic response of ocean cable structures is faced with two basic problem areas which are being addressed separately and in parallel by the R&D Cable Dynamc Program. The first is the small displacement, relatively high frequency, vibration of cables caused by vortices shed from the cable as water flows past it. This response is generally referred to as strumming. The second problem is the relatively large magnitude, low frequency gross motion of cables and cable structures generated during deployment or recovery of a structure or in-situ by time-varying environmental or man-caused forces.

Goals of this three-year program will be analytical and predictive techniques for the dynamic behavior of cables suitable for use as design tools by ocean facility engineers.

While the R&D program does not cover all problem areas associated with ocean facilities construction, it is believed it will provide NAVFAC with the ability to design and construct most of the required underwater facilities of the future.



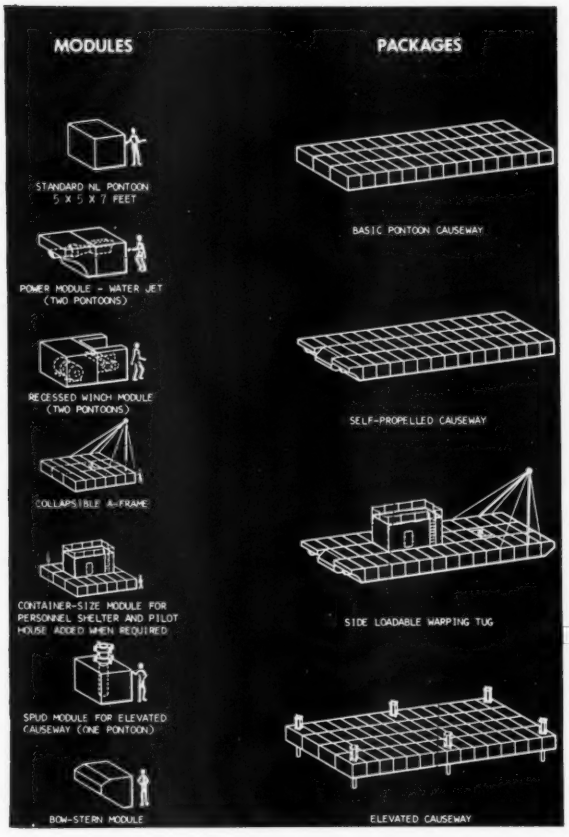
Container ships normally need dock crane facilities to unload — rather scarce items in combat zones. One project under study involves mounting portable cranes on container ships. Cranes cut cargo capacity of container ships up to ten percent, however.

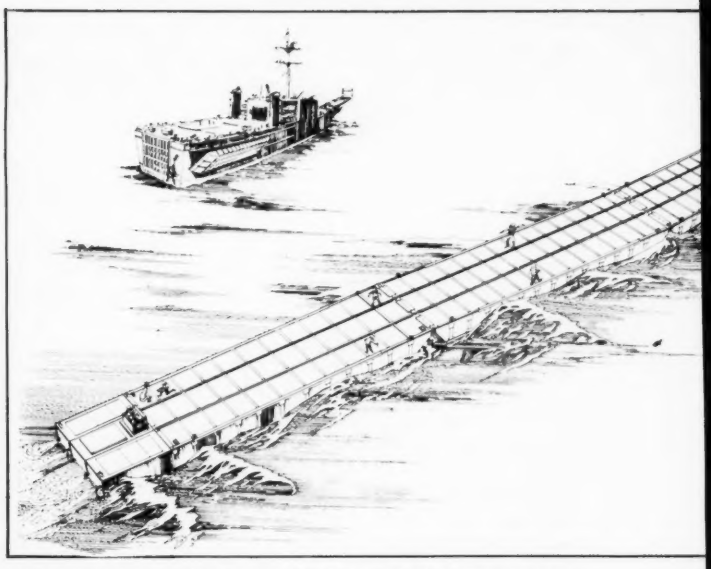
Use of an unpowered, towed barge to support a crane is another project. The Delong platform, above, showed good stability but is slow in operation and does not now meet Navy requirements for an ocean-going unit.

COTS: Container Offloading And Transfer System

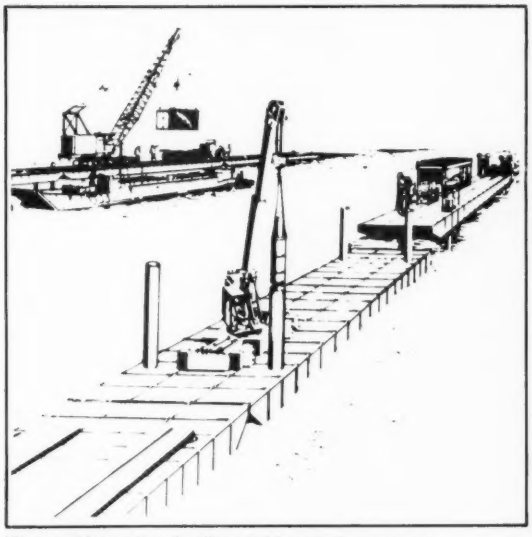
Helicopters (above) can be used to lift light containers from ship to shore — once the problem of getting hatch covers off is solved. Self-opening hatch covers, tarps, or what are called "self sustaining" container ships capable of opening their own hatches are under consideration. One radical — and simple — method of getting containers from ship to shore is balloons. See article on page 12 this issue.

Compiled by Milon E. Essoglou

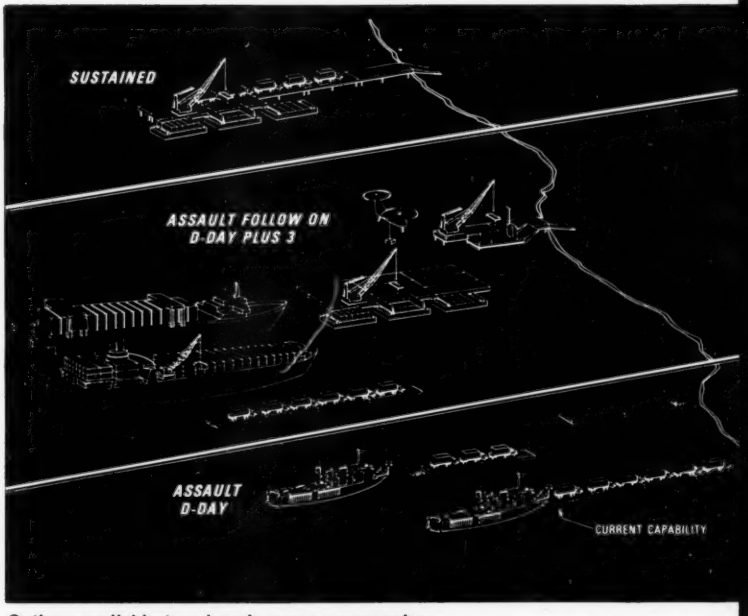

MODULES
PACKAGES
STANDARD NL PONTOON 5 X 5 X 7 FEET
BASIC PONTOON CAUSEWAY
POWER MODULE - WATER JET (TWO PONTOONS)
RECESSED WINCH MODULE (TWO PONTOONS)
SELF-PROPELLED CAUSEWAY
COLLAPSIBLE A-FRAME
CONTAINER-SIZE MODULE FOR PERSONNEL SHELTER AND PILOT HOUSE ADDED WHEN REQUIRED
SIDE LOADABLE WARPING TUG
SPUD MODULE FOR ELEVATED CAUSEWAY (ONE PONTOON)
BOW-STERN MODULE
ELEVATED CAUSEWAY



Once a container or other cargo is out of the ship's hold, it must be moved to shore. Standard pontoons — in many forms — can be used. Left is a chart of the pontoon types available and how they can be combined to move cargo from ship to shore. Above is a drawing of a typical, self-propelled pontoon causeway in action. Each causeway can support a truck.



The problem of unloading lighters in heavy surf conditions gave rise to the idea of an elevated causeway. This causeway is built of standard pontoons with special sections containing spudwells for pier posts. See article on page 17 this issue.



Options available to a beach group commander are shown above. The commander may use any combination of these options as plans or changes in operations dictate.

More Professional Reading

Considering the mission of the Civil Engineering Corps Officers School (CECOS) and its contribution to the Civil Engineer Corps (CEC), two facts have become increasingly evident:

- Beyond the traditional, billet-oriented, short courses and refresher course, CECOS has offered little to the career military professional in the matter of continuing general education.
- Self-education by means of a selective reading program is perhaps the most neglected of all learning resources.

This last has special potential virtues. It is very inexpensive; (studies in residence are costly in time and money) and the units learning gain/hour from reading a good book which appeals to the interest and needs of the reader is much greater than that gained from an hour of lecture.

Putting these ideas together, CECOS has developed a reading program of titles selected for their special value to the career military executive. The program does not include technical fields, which are the province of the Post Graduate Program. Four subject matter fields are tentatively planned:

- Management
- International Relations and National Defense
- Military History and Institutions
- Contemporary Issues in American Society

Since the opportunity for study in these fields is seldom possible, because of the nature of the engineering degree curricula, it is intended that the CECOS program for continuing education will help toward overcoming that handicap.

While experience will dictate the final form of the program, current plans suggest a time-limited assignment without examinations or formal book reviews. It will *not be a correspondence course,* and, because of the cost, it will be available only to CEC officers on active duty. Books will be stocked in the Moreell Library and sent to program participants by the librarian; some delays can be expected until stocks are built up. New titles will be added semiannually. Certain titles in the program will be *required reading; others will be elected by the reader.*

MANAGEMENT

THE CORPORATE EUNUCH, Battaglia — Tarrant, Thomas Y. Crowell, 1973. (An analysis of the costs of executive success).

THE WRECK OF THE PENN CENTRAL, Daughen — Binzen, Little, Brown, 1971. (The worst outbreak of bureaucratic botchulism in the U.S.) (The first item on the agenda for the board meeting at which the railroad was voted into bankruptcy, was to vote an annual pension of $115,000 for the Chief Executive).

THE FUTURE EXECUTIVE, Cleveland — Harper-Row, 1972. (A serious attempt to translate today into the attributes of tomorrow's managers).

INTERNATIONAL RELATIONS & NATIONAL DEFENSE

WITNESS TO HISTORY, Bohlen — W. W. Norton, 1973. (Personal account of the diplomat who participated in the major events of the U.S.-Soviet relations, 1929-69).

PRAGUE'S 200 DAYS, Schwartz — Praeger, 1969. (An hour by hour account of Soviet occupation of Czechoslovakia to end the Democratization attempt by Dubcek, 1968).

THE GREAT TERROR, Conquest — MacMillan, 1973. (A detailed account of Stalin's reign; consolidation of the first of the Communist regimes. A pattern for those that followed).

MILITARY HISTORY AND INSTITUTIONS

THE FRANKLIN COMES HOME, Hoehling — Hawthorn Books, 1974. (Of a complement of 2,500, eight hundred died on the carrier Franklin; hit by an aerial bomb, her deck aswarm with aircraft fueled and armed, she became an inferno; 700 men saved her and brought her home. How they did it is unbelievable — and should be read by every American. It is a small book, only 126 pages, about big men).

THE BATTLE OF THE LEYTE GULF, Hoyt — Wzybright & Talley, 1972. (The battles in the Leyte Gulf; Surigao Straits, and San Bernardino Straits, eliminated Japanese seapower in the Pacific. The rest of the war was post script).

ESCAPE FROM COLDITZ, Reid — J. B. Lippincott, 1973. (A classic among the escape histories. For over four years, the prisoners of war, out-numbered by German guards, in an escape-proof castle, through unremitting persistence, courage, genius (among other things) continually engineered escapes. One wonders how often the guards qualified for R & R).

DISASTER AT BARI, Infield — MacMillan, 1971. (On the night of 2 December 1943, the allies suffered the worst naval disaster since Pearl Harbor; seventeen ships destroyed, eight disabled by Luftwaffe bombers. Over 1,000 died; one of the ships, which exploded, carried a cargo of one hundred tons of mustard gas. Only the crew of the ship knew of the deadly cargo . . . all of them died when the ship exploded. News of the disaster was not made public until long after the war).

SOUTHEAST ASIA: BUILDING THE BASES, Tregaskis — GPO. (The Seabees did it, and Mr. Tregaskis wrote a good book about it).

CONTEMPORARY ISSUES IN AMERICAN SOCIETY

GULAG ARCHIPELAGO, Solzenitsyn — Harper & Row. (Detailed, documented account of the Soviet secret police installations, labor camps, prisons which form the Archipelago).

THE AGE OF DISCONTINUITY, Drucker — Harper & Row, 1968. (An informed analysis of what's happening, causes and effects in the evolution of American Society; particularly good development of the knowledge society into which we are evolving).

WORKING, Terkel — Pantheon, 1974. (The words of several hundred Americans, talking about their jobs and how they feel about working; the work ranges from garbage handler to producer of TV commercials to prostitute to laborer to ex-corporation president. A tremendous work; all managers should read it — strike that: Everyone should read it).

THE WORKING CLASS MAJORITY, Levison — Coward, McCann & Geohegan, 1974. (If the blue-collar workers should ever become a unified political force, what would result? After all, their numbers are great, and maybe — the majority. What does that mean?).

DUPONT: BEHIND THE NYLON CURTAIN, Zilg — Prentice-Hall, 1974. (They arrived as refugees from the French Revolution in 1799; today, they own the State of Delaware. Certainly, they are the oldest enterprise in this country, by far. How did they do it?).

JUSTICE UNDER FIRE, Bishop — Charterhouse, 1974. (A comprehensive, objective analysis of military justice in comparison to civil justice; best available, highly recommended).

Details of the certificate requirements and an annotated bibliography within each of the four fields of study are available upon request in writing from the Academic Director or Director, Management Division, Naval School, Civil Engineer Corps Officers, Port Hueneme, California 93043 — Autovon 360-5655.

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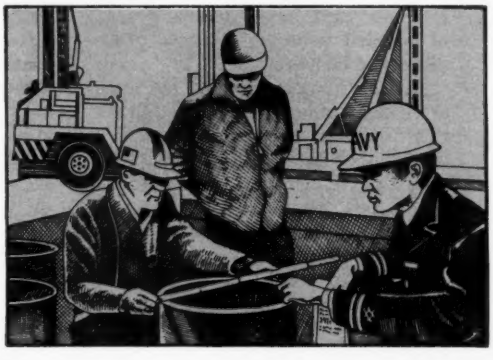
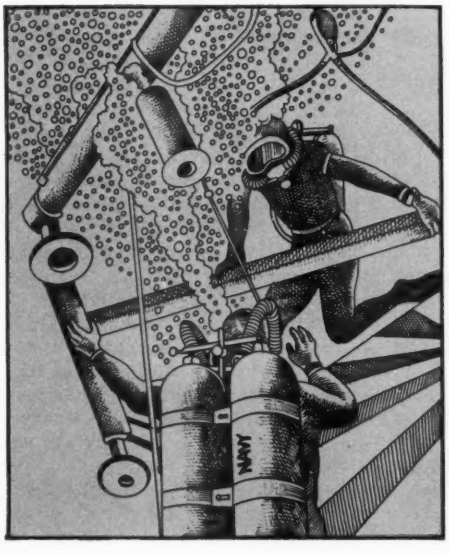




CIVIL ENGINEER CORPS
UNITED STATES NAVY

It's your life. Lead it.
Be a Naval Officer.

READERS
Please Forward This Copy To Any Young Person Who May Be Interested

By Dr. Arthur Widawsky
Director, Program Management Office

Floats are attached to the Aqua Fence boom as it is manually unreeled. The boom passes over a ramp as it is lowered to the water. A small boat pulls the boom out of the water.

NO CALM OVER OILED WATERS

The objective of the Harbor Oil Spill Removal-Recovery Systems program is to develop systems to perform the following functions in both confined and open harbor areas: contain the spill; remove oil from the water; store and transfer the oil-water mixture; and separate oil from water.

Each of these four functions is performed by a different subsystem.

The complete program has been divided into three phases. The objective of Phase I, completed in FY73, was to identify the best commercially available systems "off-the-shelf" subsystems.

The objectives of Phase II, to be completed early FY76, are to develop standard performance testing techniques for booms and skimmers, to improve performances of booms and skimmers, and to develop boom support systems so booms can be deployed and retrieved.

The objectives of Phase III, to be completed during FY77, are to conduct cold weather tests of the systems, performance tests on new equipment, and to predict and validate cost effectiveness of the systems.

Containment Subsystem

Six containment booms were tested under contract. The tests were divided into the following series: seawater soak tests; transportation, deployment and retrieval; straight-line tows; catenary tows; maintenance and repair; oil containment capabilities; tensile strength of coupled sections; cleaning procedures; and buoyancy.

Seawater tests determined the extent of marine fouling and material degradation. No visual evidence of material or mechanical degradation of the booms was observed. However, in subsequent tensile tests, the soaked 15-foot sections were more likely to fail at the joints than the unsoaked sections.

Tests were conducted to determine the equipment, time and personnel required to transport, deploy and retrieve each of the booms. Maintenance evaluation was divided into two tasks, uncoupling and recoupling in the water and repair of a damaged section.

The oil containment tests, conducted in a contractor's water storage basin, showed only one boom was able to be towed at 1.5 knots in a 1-mm thick oil slick without significant amounts of oil escaping under the boom.

Removal subsystem

Ten removal subsystems were tested under contract. Performance test variables included oil type, Navy Distillate and Navy Special Fuel Oil; speed of the subsystem; wave height; debris; and Naval Research Laboratory surface film. The measured quantities were oil pickup rate (gpm), collection efficiency (percentage of oil in the oil-water mixture picked up), and throughput efficiency (the percentage of oil encountered in one pass which is picked up).

It was found simple weir skimmers for confined areas are not effective in waves and that a small skimmer using the inverted belt principle is not effective in waves greater than half a foot.

Other skimmers were able to operate at the highest wave condition tested — three feet. However, performance decreases as wave height increases.

Storage and transfer subsystem

Performance and operational tests were conducted under contract on three pumps and two towable tanks. The objective of the pump tests was to determine flow rate, power requirement, and transfer hose pressure drop associated with transfer of oil-water mixtures.

It was found that type of oil and oil concentration has little effect on flow rates and power requirements but did significantly affect pressure drops. Towable tanks were tested for towing forces and maneuverability.

Tests were conducted at speeds up to five knots. Towing forces were far from uniform and, depending upon conditions, fluctuated in a fairly regular fashion with considerable variation in amplitude.

Separator subsystem

Two coalescing type separators and one parallel plate gravity separator were tested under contract. The tests showed the performance of the coalescer separators was sensitive to variations in the concentration of oil in the influent. The gravity separator was able to tolerate any mixture of oil and water.

Evaluation of complete oil spill

The selection of subsystems for confined and open sea systems was based on subsystem results. The confined area system used the Aqua Fence boom, JBF DIP 1001 and SLURP skimmers, Parker pump, and Dresser and Heil separators operating in tandem.

The open area system used the Aqua Fence and Sea Curtain booms, JBF DIP 3001 and 1001 skimmers, Parker pump and Sea Container towable tank, and Dresser and Heil separators operating in tandem. System tests were conducted under contract at Long Beach Naval Shipyard, Calif.

The boom was drawn into a continuous loop by a motorboat and then spliced and moored in a triangular configuration. The DIP-1001 skimmer was placed within the boom, debris was introduced and dispersed with a fire hose, and 100 gallons of Navy Distillate were pumped into the water. When the

oil stabilized, the resulting average oil thickness was about 1.5 mm.

Recovery of the oil began using the DIP 1001 and continued for two hours and 10 minutes when approximately half of the oil had been recovered. Then the SLURP was operated until all the oil was recovered. The two skimmers were operated a total of three hours and 43 minutes. The output of both skimmers was pumped into the separator system. Oil concentration in the final effluent discharge from the Heil-Dresser system varied between 1 and 5 ppm.

The following summarizes two essentially identical open area tests. Two 150-foot sections of Aqua Fence were joined to the bow of the DIP 3001 to form a "V". Three hundred feet of Sea Curtain were positioned downstream of the DIP 3001 as a safety measure.

The DIP 1001 was secured to the Sea Curtain. Seventy-five gallons of Navy Distillate were released in the "V", yielding a slick thickness of 18.2 mm. It took approximately one hour for the DIP 3001 and DIP 1001, acting simultaneously, to recover the oil.

The contents of the DIP 3001 storage tank were pumped into the separator system, and the contents of the DIP 1001 collection well were pumped into the Sea Container and then pumped into the separator subsystem. As with the confined area test, the water effluent from the separator subsystem contained 1-5 ppm of oil.

During the confined area test, nine people deployed 300 feet of Aqua Fence boom in 25 minutes. The boom was retrieved in 20 minutes by 11 people. During prior tests conducted under contract, four people deployed 300 feet of Sea Curtain boom in 11 minutes and three people retrieved it in 19 minutes.

Under Phase II, procedures and equipment are being developed with the goal of deploying 500 feet of boom, from piers up to 20 feet high, in a maximum 15 minutes using not more than three unskilled people. Tests using a newly developed power assistance unit have shown this goal has been met.

As a result of harbor tests, the following human factor recommendations were made concerning the JBF DIP 3001 skimmer and subsequently adopted by the manufacturer.

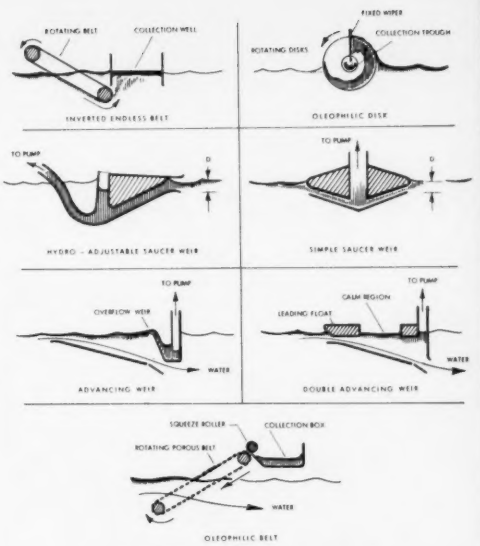
- Place an oil-water level capacitance sensor in the oil well
- Raise the pilot house to improve the operator's observation capability
- Redesign machine space to improve accessibility
- Install a better railing
- Install a more stable walking platform over the machine space
- Install boom and connectors on the bow
- Provide better lighting
- Place all hydraulic controls in the pilot house

Phase II

The standard performance test procedures developed under contract will be used this summer to test booms and skimmers at EPA's OHMSETT (Oil and Hazardous Materials Simulated Environmental Test Tank) Facility. A boom with a frontal screen to dissipate kinetic energy, developed under contract, will be tested to determine its oil containment capability.

DIP 1001 and 3001 skimmers will be tested to determine optimum values of belt speed and back plate opening. A boom support system, including a boom container and a power assistance unit for deploying and retrieving boom, is being developed under contract.

In addition, the following boom utility equipment will be evaluated by CEL this summer: two utility boats, a flattop boat, and two boom mooring systems. Other Phase II tasks are the development of 10 oil spill cleanup scenarios and human factors and safety measures, an oil spill data feedback procedure, and criteria for selecting boom materials.



Principles of skimmer operation.

With EPA approval, 100 gallons of Navy Distillate fuel were spilled inside the triangular Aqua Fence boom. Styrofoam chips simulated debris. The JBF DIP 1001 skimmer (foreground) removes oil from the water. Oil is pumped from the enclosure to a pier for separation. Water spray pushes oil toward the skimmer.

Acknowledgments

The following CEL personnel participated in selection and testing of the Phase I subsystems and systems: Containment-Dr. J. J. Der; Removal-D. J. Graham; Storage and Transfer-E. J. Beck; Separation-J. S. Williams; Systems-D. J. Graham and J. S. Williams.

Dr. R. H. Fashbaugh contributed administrative support and with E. J. Beck participated in evaluation of the contractor's qualifications. The Phase II contract work on booms and skimmers was monitored by D. E. Brunner and Dr. S. C. Garg. The program is coordinated by Dr. A. Widawsky under overall supervision and guidance of Dr. A. J. Paszyc.

Reference

Civil Engineering Laboratory. Development of Harbor Oil Spill Removal-Recovery Systems-Phase I, by A. Widawsky, Technical Note N-1372, Port Hueneme, Calif., January 1975.

ENVIRONMENT and the NAVY

By LCDR W.P. McTOMNEY, CEC, USN
Director, Navy Environmental Support Office
• Port Hueneme, Calif.

Robert Fri wrote in the March-April, 1974, edition of *Harper's Business Review*, "Despite doubts raised by the energy crisis, costs, and political waverings, the new pollution-control acts are on the books to stay; the challenges to the regulations are not as strong as some businessmen have hoped." The energy crisis turns out to help, rather than hinder, the laws.

Before the late 1960s, there was no apparent concern for this country's demands on its environment and natural resources. This has changed — with a vengeance — and federal laws and direction evolved, starting with the National Environmental Policy Act (NEPA), 1970; Federal Water Pollution Control Act amendments of 1972; and the Clean Air Act.

States and local regulatory agencies were quickly strengthened and they revised, reemphasized, or originated regulations with strong standards for compliance. Coupled with these laws was establishment of a plethora of strong enforcement agencies — the Environmental Protection Agency (EPA), State Air Resource Boards, local pollution control agencies, etc.

The awakening of the country's concern for the environment, and awareness of existing pollutants is now accepted and when the "energy crisis" became a reality in late 1973, the environmental proponents were too powerful to be deferred.

It is academic whether the energy crisis was caused by the environmentalists — as some people say — or, more likely, by poor management of our natural resources. It is more important to note that both energy conservation and a clean environment are the concerns of today's decision makers.

The good news is that in many areas the goals of these two programs are compatible and can be considered together during the decision-making process. The need to consider both goals is important in the Navy where concern for — and impact on — the environment is due to extensive operations on the sea, in the air, and at shore installations.

Since the majority of Naval complexes are located in large metropolitan areas, such as San Diego, Norfolk, San Francisco, etc., the Navy has become more involved with local communities in trying to solve common environmental and energy-related problems.

Some of the primary problems are fuel conservation and compliance with the Clean Air Act and other air pollution control regulations. Transportation represents the largest single source of air pollution, in addition to representing 25 percent of the nation's energy requirements for fuel.

The Navy's policy is to comply with standards that require emission devices or no lead fuel. The Navy also advocates maximum use of car pools, reduced speed, fewer trips and smaller cars in an effort to conserve fuel — the same requests made for a number of years by environmentalists.

Stationary air sources represent another serious polluter and major energy user. However, the Navy's "Boiler Tune Up" program is attacking this problem right now. Since a majority of larger boiler plants (5M BTU/HR heat input) are of World War II vintage, many are operating now at less than peak efficiency.

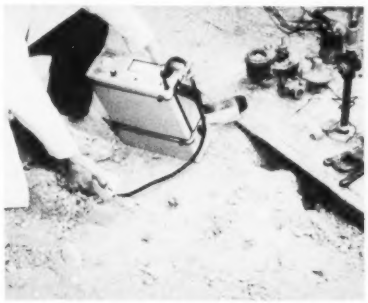
(cont. on pg. 35)

TECHNICAL NOTES

Leak seeker takes gas

The location of leaks in buried utility lines (e.g. compressed air, natural gas, steam) is of principal concern toward eliminating the inherent energy loss.

However such a leak detection procedure must comply with the following imposed working constraints: cause no/



Leak detector measures concentration of sulfur hexaflouride gas in holes bored along a pipeline.

minimum system shut-down time; ease of detection procedure; and portability of equipment and all at a minimum cost.

Toward this effort, CEL has demonstrated the feasibility of detecting sulfur-hexafloride (SF_6) tracer gas with commercially-available detectors to provide a solution to the Navy's underground utility line leak detection problem.

Basically the leak detection procedure is as follows: make holes in the earth or surface cover (3/8-3/4 inch diameter, 4-8 inches deep) 4-6 feet apart along the buried line; inject SF_6 into the system, with the utility line under flow conditions, at the primary supply source; and check for SF_6 in the holes above the line with the detector (escaping SF_6 will collect in holes because of its high density).

Some particulars of this SF_6 application are: the SF_6 is nontoxic and inert; the amount of SF_6 used depends upon system size and usage, but is generally in the order of 10^6 volume of the static system; the detector weighs 24 pounds, is 12 inches x 5 inches x 15 inches and is simple to operate; and finally leak detection time is dependent upon the size of the leak, system pressure, depth of buried line, and soil conditions. However most leaks are generally detectable within 1-2 hours.

The SF_6 tracer gas procedure is found to be more expeditious and accurate than existing traditional detection methods in locating buried leaks. It is a good maintenance tool.

For further information contact: Frederick H. Herrmann, Autovon 360-5554; (805) 982-5554.

'Odor eaters?'

A chemical company has recently developed a new odor counteractant which may be obtained in aerosol cans, powder, or in liquid form. It reportedly can eliminate odors for several days without scented masking. The manufacturer claims that it has special application against human fecal, cancer and methane gas odors generated by decomposition of organic matter. It is also claimed effective in counteracting mustiness and painting odors. This product is currently in the process of being stock listed for federal use.

Additional information may be obtained from John Leimanis, Naval Facilities Engineering Command, Alexandria, VA, autovon 221-8182.

Oil spill equipment manager named

NAVFAC has established an oil spill equipment program manager at the Civil Engineer Support Office (CESO), CBC, Port Hueneme, Calif. The CESO program manager will provide procurement services, logistic support, periodic updating of the Integrated Logistics Support Plan (ILSP), and general support in resolving equipment and procurement problem areas relating to oil spill control equipment for use in harbors and ports.

Questions relating to this oil spill equipment, including procurement status, delivery schedule, repair parts availability, and technical consultation should be directed to George Clouden, Autovon 360-5678/4029, Comm (805) 982-5678/4029 or by writing Commanding Officer, NCBC Port Hueneme, CA 93043, Attn. Code 153.

Beam proves to be an 'untrussworthy support'

The recent failure of a wood roof truss (approximately 100 feet long) in an aircraft industrial building again emphasizes the critical need for proper structural control inspections as outlined in NAVFAC Notice 5100 of 20 December 1971.

On-site investigation revealed that the failure was caused by the following factors: underdesign, use of poor quality lumber during wartime construction (early 1940s), inadequate bolt tightening following construction (the first two years), and vibrations in the facility.

The trusses were shored up as an interim measure. Recommendations for permanent repairs included the following alternatives:

- **Most economical and least disruptive to activity — install steel box trusses over the existing roof and provide hanging supports to existing wood trusses.**
- **Shore up the roof and replace the wood trusses with new steel trusses.**

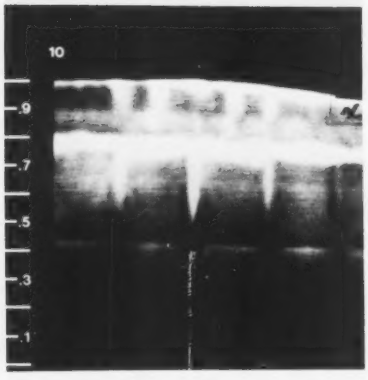
Additional information may be obtained from A. S. Gallup, P. E., Norfolk, VA, autovon 690-7121.

Continued From Preceding Page

PUBLIC TECHNICAL

Infrared technology tackles energy waste

That any object gives off radiant energy in proportion to its temperature is a well-known phenomenon which can be observed by the human eye when looking at hot objects such as heating elements, glowing coals, blue flames, etc.



Infrared scanner measures heat loss from a structure (above). Below is a sample thermogram. Light areas indicate heat loss through openings or inadequate insulation.

This energy output continues all the way down to absolute zero. The human eye, however, cannot track it below about 500°F due to the narrow spectrum of light which the eye can see.

Energy losses in buildings, pipelines and facilities due to missing, defective or wet insulation will show up as temperature (and radiation) differences between good and bad areas. These differences will usually be on the order of a few degrees Fahrenheit on a surface that has an average temperature in the vicinity of 70°F. This temperature is obviously far below that part of the spectrum to which the eye is sensitive, and it would be virtually impossible to measure with thermocouples or other spot temperature-measuring devices all the surfaces within the naval facilities that could have a significant energy loss.

Recent developments of highly sensitive and extremely fast detectors that are responsive to radiation within the temperature range (the infrared region of the spectrum) of interest in energy surveys has made possible the commercial development of infrared (IR) imaging systems.

Such systems use horizontal and vertical prisms rotating at high speed to scan an area (which can be the complete side of a building) within the field of view of the lens system, and electrically convert the radiation signals received by the scanner to a live thermal picture displayed on a cathode ray tube.

The image can be photographed for permanent thermal records, or it can be put on tape or displayed in color for better discrimination of temperature profile. The most recent developments in imaging systems are battery-operated portable units in which the IR scanner can be hand-held.

CEL has been field testing a portable IR system for the past year at naval bases having high heating and air conditioning loads. A report is being printed which will describe how the tests were conducted and will contain many thermal photographs (thermograms) of walls (from inside and outside), ceilings, underground and above ground steam lines, hangar doors, and aerial views of building roofs.

CEL plans to continue tests and investigations of this application of IR imagery to develop techniques to the point where recommendations can be made on which types (and accessories) of portable IR imaging systems are best suited as a field inspection tool in each major application, and reference standards can be developed so by comparison of a reference image with an image obtained in the field, a decision can be made on whether or not a repair should be made.

It is also planned to include live videotaping of thermal data and tests of refractory linings in boilers in the FY76 program.

For further information contact: J. C. King, Autovon 360-5973; (805) 982-5973.

'Cooling it' for summer

Major preventive maintenance work on air conditioning and refrigeration equipment and systems should be accomplished during the winter and early spring seasons.

A good PM program will do at least four major things: prevent future trouble, permit a system to operate at design efficiency, save energy, and reduce operating costs.

The program should provide for cleaning of all heat transfer surfaces, filters, and moving equipment; calibration of all operating and safety controls; lubrication; and other appropriate seasonal maintenance work (e.g. replacement of parts which have completed a normal period of operation).

The effects of poor PM practices on the efficiency of HVAC equipment are dramatic. For example, a recent study revealed the relatively minor fouling in heat transfer surfaces of an absorption chiller resulting in a reduction in capacity of 24% and an increase in energy consumption of over 7% as compared to the system's intended design operating conditions.

Additional information may be obtained from A. S. Gallup, P. E., LANTNAVFACENGCOM, Norfolk, VA, autovon 690-7121.

Bright idea

With today's emphasis on energy conservation, and the strong directives to reduce lighting levels, getting the most light from a fixture is of the utmost importance.

Light output can be increased as much as 40% by simply washing the lamps and fixtures! It pays to keep reflectors, shields, and lamps clean. Dirty room surfaces also contribute to light losses. Clean walls and ceilings in lighter colors are a must for good lighting. Ventilated fixtures (holes or openings in cap) stay clean longer than nonventilated types. For good visibility, good morale and appearance, keep lighting surfaces clean.

Additional information may be obtained from A. S. Gallup, P. E., Norfolk, VA, autovon 690-7121.

WORKS NOTES

Continued On Following Page

For the birds

The subject of ultra-sonic or high frequency devices to repel birds from buildings comes up on a recurring basis as building custodians seek a quick solution.

Despite what may be heard from the manufacturers of these gadgets, pest species adapt to environmental changes and rapidly resume pest status after a period of adjustment (which lasts from a few days to a few months at most).

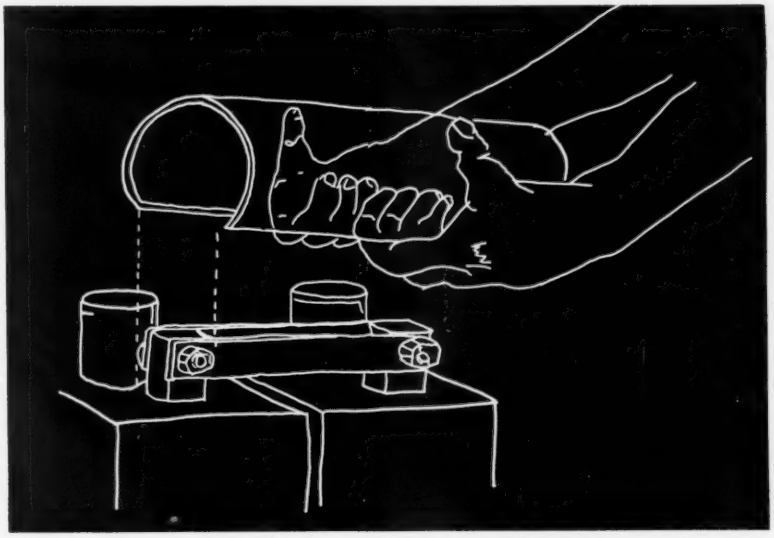
The Bureau of Sport Fisheries and Wildlife after years of studies concludes that there are no lasting effective ultrasonic devices available to control birds. Stick to good sanitation, inspection, exclusion, baiting, and trapping until somebody comes up with a better and workable idea.

Woodpecker damage is a problem that gives owners of utility poles fits. It seems rather absurd that these beautiful and otherwise beneficial birds should go out of their way to excavate nests that are certain death traps, as eggs laid in creosoted poles generally do not hatch. The fumes also finish off the few chicks that do emerge.

Ornithologists have suggested that the reason woodpeckers select these oily, stinking nesting sites is that they offer strategic territorial advantage. In any event, this suicidal tendency has damaged (or even ruined) 5 million poles in the U.S. The best preventive is to wrap high-risk poles in ½" hardware cloth.

Chemical repellents are on the market, but are of questionable value. Corrective techniques are available to fill existing holes.

Contact Harvey A. Shultz, Code 10A1, Northern Division, Naval Facilities Engineering Command (Autovon 443-3656).



Battery pole covers may prevent 'shocking' accidents

The hazard created by the exposed copper intercell connectors (bus bars) on battery banks has been a problem for many years. Maintenance personnel who must perform routine servicing (such as hydrometer checks) are exposed to potentials of up to several hundred volts with extremely high current capabilities.

An associated danger is the possibility of accidental contact between intercell connectors or terminals with a wrench or other hand tool which could disintegrate the tool and cause possible cell explosion.

Insulation from ground potential contact has been fairly well resolved by recommending sheet rubber flooring and insulated battery racks. Protection against contact between positive and negative cell potentials has been a bigger problem because of the inconsistent sizes of various cell types and intercell connectors.

A flat, clear plastic cover over the entire cell bank has the advantage of simplicity, but also has several major disadvantages: during routine cell maintenance the cover must be removed, which exposes the intercell connectors; lead acid batteries exhaust a small quantity of H_2 during charge cycles and the flat plastic cover restricts ventilation which can cause accumulation of potentially explosive hydrogen gas.

Heat shrinkable tubing over the intercell connector eliminates the above problems, but leaves the cell terminals exposed.

A simple, low cost solution to this problem is the fabrication of a cover from plastic tubing. Comoco lexan polycarbonate material is recommended due to its excellent resiliency, high resistance to sulfuric acid and its availability at most commercial plastics suppliers.

A tube diameter equal to the battery terminal height with a 1/16 inch wall thickness can be cut to the desired length and then again parallel to the centerline. The cover can be spread a considerable distance without damage for easy placement over the terminals and cell connectors. Cell vents are not covered which allows adequate gassing ventilation and since the material is a clear plastic, terminal conditions can be observed without removing the cover.

For further information, contact N. L. Baumgarten, CHESDIV, Autovon 288-4146; (202) 433-4146.

Keeping yourself in hot water

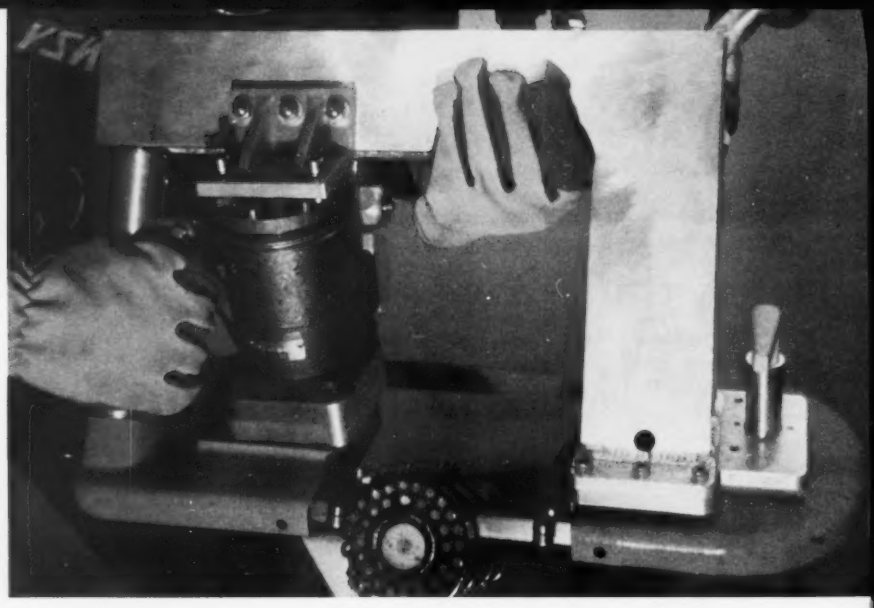
Water conservation always makes good sense. Aside from saving water, it reduces energy consumption and minimizes environmental problems at sewage disposal locations.

A low-cost effective measure to reduce waste is to install orifices on showers. Nylon inserts are available for easy insertion at the point where shower heads are connected. These orifices are maintenance free and effectively reduce the flow to about 2½ to 3 gpm for a 50 to 60 percent savings in water.

This also results in a significant savings of fuel required to provide hot water.

Additional information may be obtained from Mr. A. S. Gallup, P. E., LANTNAVFACENGCOM Norfolk, VA, autovon 690-7121.

Hydraulic saw is underwater 'cutup'



A military diver using a unique portable hydraulic band saw can cut through a 3½ inch underwater communications cable in approximately one minute. But the same diver using a conventional hack saw would require one to four hours (depending on diving conditions) to accomplish the same task.

Little effort is required by the diver since the weight of the 25-pound power tool provides the cutting force.

The need to quicken the cutting and repairing of underwater communications cables led NAVFAC to assign the project to CEL. The laboratory considered as impractical existing devices such as saber saws, large piston-type cutters and explosives. It took six months to design, fabricate and test a first-of-its-kind model. A prototype is being built for delivery this summer to an Underwater Construction Team (UCT) for operational evaluation.

During a recent job off Midway Island, the experimental tool cut a 2½ inch cable in 10 seconds in 60 feet of water.

CEL tested several commercial electric band saws, comparing them for basic performance and potential conversion to hydraulic power. Conversion to an underwater hydraulic unit included: selection of a low-speed, high-torque motor to turn the drive-wheel at the proper RPM to achieve a blade speed of 250 surface feet per minute; design of an on/off valve and trigger mechanism; and design of a new aluminum framework.

The endless saw blade is 44-7/8 inches long and rides on two wheels, each six inches in diameter. Total tool length is 19 inches and it measures 12 inches high. Although designed for a specific task (cutting 3½ inch cable) the portable hydraulic band saw can easily be modified to cut objects five inches in diameter. Anything larger would make the band saw unwieldy for hand-held operations.

For further information contact: Phil Rockwell, Autovon 360-5940; (805) 982-5940.

Keeping lights shining brightly

What is a sound preventive maintenance program for airfield lighting?

To answer this question, Northern Division's industrial engineers queried six electrical foremen and estimators from various Naval Air Stations and a commercial airport. Despite the geographic dispersion of the airfields, the personnel consulted favored weekly replacement of defective lamps, unless airfield operations are affected by an excessive amount of lamp failures.

Significant outages, occurring between the weekly public works replacement schedules, are reported by the control tower or by the fire/crash truck crews which conduct daily runway and parking apron checks. Based on the experience of these on-the-job experts, daily maintenance checks, which are performed at some naval activities, do not represent effective and economical utilization of public works type manpower.

Additional information may be obtained from W. G. Shafer, Northern Division, Naval Facilities Engineering Command Philadelphia, PA, Autovon 443-4861.

Grounds care with less care

Grounds maintenance is one "not so glamorous" duty that challenges the ingenuity of a public works department.

At the Naval Air Station, New Orleans, the climate, funding requirements, and a small work force have sent the public works staff searching for alternatives to mechanical methods.

A local innovative firm was contacted which had successfully used chemical methods of controlling grass growth. The approach was to carry out a "release program" whereby all weeds are killed and the native Bermuda grass is allowed to spread and become the ground cover. Based on this principle, a pilot test was conducted with outstanding success. Subsequently, a contract for weed control on approximately 700 acres along the station runways was awarded which included soil sterilization around lights and markers. After two years it appears that the grass release program is by far the most economical program for control of grass in semi-improved areas.

Additional information may be obtained from LCDR P. A. Goins, Publics Works Officer, NAS New Orleans, autovon 363-7363.

It is said there's always a way to build a better mousetrap and this section of The Navy Civil Engineer is designed for ready exchange of better ways to perform Public Works functions. Readers who desire additional information are urged to contact the contributor directly for specific details. Contributions are urged from field installations and should be directed to John S. Biggs, PW Technical Coordinator, Code 1013, Headquarters, Naval Facilities Engineering Command, 200 Stovall Street, Alexandria, VA 22332; Autovon 221-8182 or (703) 325-8182. Coordinator for RDT&E subjects is Eugene H. Early, Code L03C, Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, CA 93043; Autovon 360-4070 or (805) 982-4070.

ENVIRONMENT and the NAVY

(cont. from pg. 30)

This program calls for adjusting boiler fire control settings, optimizing operations for best steam-fuel use, and maintenance and repair with a resultant conservation of fuel.

Initial results show an annual savings of over 450,000 gallons of fuel at 17 Naval activities with a potential total savings upon completion of this program of 30 million gallons per year. After a boiler is "tuned" for coal, number six fuel oil, or other "dirty" fuels, a source emission test is conducted by actually sampling emissions from the stacks.

This more efficient boiler operation also produces cleaner air. Saving fuel and emitting less oxides of nitrogen and particulates into the atmosphere are being accomplished and similar savings are being realized on other industrial processes.

Solid waste and hazardous material disposal is another area of recent environmental concern and, coupled with the depletion of natural resources, it is also of concern to energy conservationists.

A major problem is what to do with some million tons of solid waste generated at Naval activities each year, the majority of which ends up in sanitary land fills. Land fill sites are coming under more stringent regulations and their availability is quickly diminishing.

Up to 60 percent of this material is reclaimable and recycling programs can have a major effect on reducing solid waste. Many Naval activities have active programs underway and recent NAVCOMPT direction, initiated through NAVFAC, now allows activities to reclaim costs associated with these programs and an even greater emphasis is expected in recycling efforts as a result.

EPA reports six cities including Chicago, St. Louis, and Bridgeport, Conn., are committed to resource recovery projects involving garbage burning power plants. Seventeen other major U.S. cities are considering using solid wastes as a fuel for power plants.

The Navy was, of course, a forerunner in this area with their "eco-fuel" plant at Norfolk. Design is underway for a similar Navy facility at Philadelphia. Again, an area where environmental objectives are compatible with energy and where the problems can be tackled together.

Oil spills, a major source of Navy pollution, has obvious impact in these areas. Eliminating accidental spills and minimizing operational ones will not only increase fuel availability, but alleviate impact on the environment.

Environmental research and development efforts underway also consider the impact on energy. Accurate field measurements through the Naval Environmental Protection Support Service specialty teams verify the need for sophisticated abatement equipment to ensure only needed pollution abatement equipment is installed to reduce energy drains.

There are areas where the combined goals do not coincide, such as the total energy required to meet standards under the FWPCA. Technology has solved and can solve these problems though, particularly now that the decision maker is more aware of these problems and is taking the environmental and energy requirements into consideration simultaneously.

There has been no relaxation of environmental standards because of the energy crisis. If anything, more awareness in both areas has arisen. National goals of zero discharge in 1985 and energy independency by 1980 are idealistic and the challenge is there for the Navy decision maker to manage energy resources so they are compatible with the environment.

For now, and into the future, decisions will be based upon the four Es — Engineering, Economics, Environment, and Energy. Solving one problem will provide a quantum jump to solving the other.

What is a CESO?

By CDR. JOHN C. TOTTEN, CEC, USN
Director of Civil Engineer Support Office

• Port Hueneme, Calif.

The conversation usually starts with, "Where are you now, John?"

And I reply, "I'm at Port Hueneme, as director of CESO."

Then follows, "Oh, really? What's CESO?"

Or sometimes, "You mean the Lab?"

Or maybe, "I always thought CESO was a Captain's billet."

Be it known herewith that there *is* a CESO, it is not "the Lab," and it is a commander's billet. Once known as SSEO (Seabee Systems Engineering Office), it was re-named Seabee Support and Equipment Office in 1971. The present name, Civil Engineer Support Office (CESO), was assigned in 1972.

Officially, CESO is a staff office of the Naval Construction Battalion Center, Port Hueneme, and functions as a decentralized portion of Naval Facilities Engineering Command Headquarters.

CESO's output can be classified under five major product areas: Seabee support, NAVFAC material management, the advance base functional components system (ABFC), standard specifications, and management systems. CESO has a civilian ceiling of 184 and a military allowance of ten officers (eight Civil Engineer Corps and two Supply Corps), and 24 enlisted personnel (17 actually on board).

ANALYSIS OF PERCENTAGE OF WORKFORCE

CESO Civilian Personnel	Number	Percentage
Engineers	32	17
Engineering technicians/draftsmen	8	4
Equipment Specialists	14	8
Program Managers	26	14
Program and Systems Analysts	25	13
Budget Analysts	5	3
Inventory Managers	9	5
Procurement/Preservation and Packing	8	4
Supply Clerks	7	4
Supply Catalogers	6	3
Operations Research Analysts	3	2
General Administrative	3	2
Clerical	38	21
Subtotal	184	100
Civilian percentage of total workforce	——	84
Military:		
Officer	10	5
Enlisted	24	11
Total	218	100
Senior Supervisors	11	5
First line Supervisors	22	10
Non-supervisors	185	85

Percentage of Effort By Output:

29% Seabee Support
21% Navy-wide Equipment Management
12% NAVFAC Material Management (2C Cognizance)
14% Advance Base Functional Components
18% Standard Specifications
6% Management Systems

Percentage of Effort By Input:

21% Program III (Engineering)
17% Program IX (Public Works)
62% Program VI (Seabees)

In the area of Seabee support, CESO provides staff support to the Deputy Commander for Manpower of HQNAVFAC, involving training requirements and advancement qualifications. Direct support is provided through the personnel readiness capabilities program. In addition, CESO provides support in equipment management and Tables of Allowance, makes logistic assistance visits, and provides

If you, too, are unsure, read on!

funding for and allocation of contingency support material. The Seabee Support department, while not in the chain of command, serves certain Seabee units in type commander functions of a technical nature.

A major effort was the restructuring of the Tables of Allowance, to make the format easier and more meaningful to allowance holders. Other recent accomplishments include distribution of nine issues of the CESO Equipment Maintenance Bulletin, 16 assistance visits to Seabee units, and numerous briefings on the Coordinated Seabee Allowance List and Tables of Allowance.

The Seabee Support Department reviewed formal school curricula, 33 proposed Seabee technical training courses, and eight rate training manuals. The Seabee Planner and Estimators Handbook was revised, and should soon be distributed.

In carrying out the CESO-NAVFAC material management mission, support is provided to the Assistant Commander for Military Readiness and the Assistant Commander for Operations and Maintenance. CESO is responsible for the procurement of all civil engineering support equipment and civil engineer end-items. This includes compiling both the Naval Construction Force and shore establishment requirements and preparing the budget for submission by NAVFAC to higher authority. CESO also initiates and monitors the procurement actions . . . averaging $45 million annually over the past five years. Execution of this budget, which affects NAVFAC managed supplies and equipment on a world-wide basis, is a demanding responsibility requiring both an intimate knowledge of needs and the making of many hard decisions.

A significant material management milestone was the successful acceleration of the FY75 OPN procurement. By 15 January 1974, 92% of the FY75 funds were obligated. As of 1 March 1975, 97.4% were obligated. The equipment managers completed some procurement programs in minimum time. An example was the 43 recruit-mobiles obtained in support of the all-volunteer Navy. In addition, work was begun on a Supply Operations Handbook, technical manual stocks were centralized at the Construction Battalion Center, Port Hueneme, and a new budgeting concept was developed.

Another responsibility of CESO was the execution of the Mobile Utility Support Equipment (MUSE) program. This program offers interim utility support of Navy Department requirements to meet the needs of forces afloat the the shore establishment. During FY74, CESO deployed 91 assets under this program, and in cooperation with the Naval Nuclear Power Unit, inspected 24 activities with some 33 assets. On 1 July 1975 this function was transferred to the Navy Nuclear Power Unit MUSE Detatchment, Port Hueneme.

Management of the Advance Base Functional Components System involves liaison with all naval bureaus and systems commands. CESO prepares and promulgates documentation of the system, such as the facilities planning guide, and manages contracts for the design, fabrication, test and evaluation of system facilities. CESO also updates the system on a continuing basis, performs engineering design and prepares material requirement lists. A major accomplishment was the complete redesign of the system to relate to Department of Defense facility category codes and the Navy's shore facility planning system. The Facilities Planning Guide, key to the system, was distributed in late 1973.

A breakthrough was made in the completion of the Tactical Containerized Shelter System, known as TACOSS. This was a $750,000 contract to manufacture ten 8'x8'x20' containerized shelters. Seven of these expand to 24'x8'x20' when in use. Seven of the ten were designed to support a Seabee team. The other three are intended to augment other camp or base requirements.

The Functional Components Department completed a building evaluation study which is used to compute life-cycle costs for various shelters. All variables were expressed in terms of cost, and all costs were based on current value techniques. The result is a ranking of several shelter systems in ascending order of life cycle cost per square foot.

Table I. Listing of Ten TACOSS Units

TACOSS I
Detachment Subsistence Unit (Expandable)
TACOSS II
Detachment Sanitary Unit (Non-Expandable)
TACOSS III
Detachment Medical Unit (Expandable)
TACOSS IV
Provision Storage (Dry, Frozen, Refrigerated)
TACOSS V
Equipment & Shop Unit (Expandable)
TACOSS VI
Detachment Personnel Unit (Expandable)
TACOSS VII
Utility Unit (Expandable)
TACOSS VIII
Frozen Storage Unit (Non-Expandable)
TACOSS IX
Galley Unit, Large (Expandable), 250-man
TACOSS X
Sanitary Unit, Large (Expandable), 100-man

Progress on the final designs for all medical series functional components continues under a $2.2 million contract administered by CESO. The Army recently agreed to accept these designs in toto . . . with obvious savings to the taxpayers. Many other components, facilities and assemblies have been redesigned.

Research and development efforts managed by the functional components department include the definition of Seabee and advance base functional component R&D requirements by priority. Others are a project for the development of a containerized intermodal desalinization system, and solutions for various problems of the Amphibious Construction Battalions.

CESO is responsible for managing standardization in assigned federal supply classes, and reviews and coordinates the input of all naval commands for about 100 classes of material, from railway to food preparation and serving equipment.

The management system area of responsibility includes system development, management support studies, and working proponency for assigned systems. ("Working proponency" is defined as an office or an individual who represents a given subsystem, monitors its effectiveness, and coordinates its maintenance requirements.)

Systems development covers such tasks as the design, documentation, determination of specifications and implementation of management information systems for the entire Naval Construction Force. Some examples were an update of the automated advance base functional components system, modification of the procurement status reporting system, and the development of the personnel readiness capabilities program.

Management studies include the analysis of current and proposed CESO programs, operations and procedures to determine management requirements and effectiveness of performance. Operations research and quantitative analysis are two of the techniques used. Among the tasks completed were feasibility studies in several areas, and NAVFAC's contribution to the DOD study of construction equipment management.

The third and final systems activity is working proponency. The working proponent of a subsystem has specialized knowledge and is able to initiate proposals for changes to the subsystem, to evaluate proposals submitted by other subsystem users, and to assess their impact on the total system. In effect, he acts as a direct agent of the system proponent in the day-to-day development or operation of the FAC06 portion of the Naval Facilities System.

CESO is the working proponent for such systems as the Construction Battalion Center Management Information System (CBCMIS), the Civil Engineer Support Management Information (CESMIS), and the Construction, Automotive and Special Equipment Management Information System (CASEMIS). The working proponency in the CBCMIS is in the subject areas of Supply, Public Works and Construction Equipment Departments.

So, what is CESO? CESO is support for Navy civil engineers and construction forces. The foregoing outlines some of the areas in which this support is provided, but certainly not all.

If more detailed information or assistance is desired, contact CESO by mail or by phone. The AUTOVON number is 360-4991/4992. Your call will be turned over to a specific subject matter specialist. The mailing address is: Civil Engineer Support Office, Naval Construction Battalion Center, Port Hueneme, California 93043

CORROSION

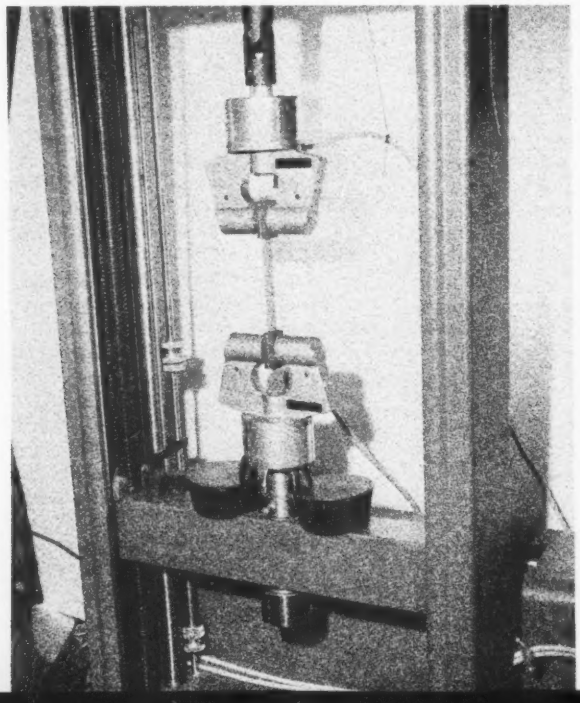
The Navy counterattacks the elemental enemies of nearly everything built by man

Deterioration of materials exposed to the marine environment (atmospheric and seawater) at naval shore facilities remains a constant and expensive problem. Such deterioration consists of corrosion of metals, abrasive degradation of coatings and other materials in some use situations, and chemical breakdown as the result of exposure to sunlight, rain, salt water, etc.

Scientists at the Civil Engineering Laboratory (CEL) are attacking the predicament on various fronts. Methods of control include use of protective coatings, substitution of plastics for metals, or introduction of inhibiting materials which may apply to biological, chemical or physical attacks.

To reduce current annual costs of more than $9 million for maintenance of roofs at naval shore facilities, CEL has been conducting a research and development study on roofing.

A free film of a coating system is tested on this stretching device.



Experimental foam coating is sprayed on a roof. Foam is coated with elastomeric coating systems after it hardens.

To determine the nature and causes of roofing failures, survey of various Navy shore bases has been conducted.

First experimental studies were devoted to roofing systems consisting of sprayed-on polyurethane foam protected with elastomeric coatings. Experimental foamed roofing panels two feet wide and four feet long are being subjected to environmental field exposure at Port Hueneme (marine location), NMC China Lake (desert location), and Pickel Meadows, Calif. (cold weather location).

Coating systems in the program include butyl, hypalon, butyl plus hypalon, neoprene plus hypalon, urethane, silicone, acrylic latex elastomer, chlorinated rubber, and aluminum asphalt. Other laboratory studies conducted on each of the coatings include free-film tests to determine tensile properties, adhesion to foam after different periods of experimetnal weathering, and resistance to wind-driven rain.

In addition, a field experiment is being conducted at Naval Reserve Center, Clifton, N.J. where Butler-type roofs were divided into sections and foamed and coated with five different elastomeric coatings. Attics, roof deck, and foam were thoroughly thermocoupled to determine insulation efficiency of the foam. Results indicate a high value of insulation and a reduction in fuel usage of 50% to 65% between the winters of 1972-73 (before foaming) and 1973-74 (after foaming).

In addition, CEL is investigating materials and procedures for preventive maintenance of roofing, roofing systems for cold and for tropical areas, and the effects of moisture on BUR performance.

Ultimate goals are reduced roofing maintenance costs through better use of existing materials, development of new maintenance techniques, procedures, and materials, and development of roofing systems unique to climatic requirements. ***By J. R. Keeton and Dr. R. L. Alumbaugh***

Water blasting is used to remove degraded paint from stucco.

Experience has shown periodic cleaning of painted surfaces not only enhances the appearance of the surfaces, but adds life to the protective paint film by removing contaminants that accelerate its deterioration. CEL studies have shown optimum cleaning procedures vary with the type of painted surface and with the contaminant (e.g., soot, oil, fungal growth, etc.).

Thus, variations should be made in pressure, temperature and detergent composition of water used in the washings of painted building exteriors according to the prevailing conditions.

High pressure and high temperature water with or without strong detergents may also be effective in preparing a surface for painting. No precaution is necessary for protecting the old paint during the cleaning process but care must be taken to avoid damage to wood and masonry substrates.

CEL also is investigating improved maintenance painting procedures to reduce costs significantly. The goal is to develop a program to include surface preparation, selection of coating materials, application procedures, and repainting schedules. Field tests are underway at several Navy field activities to produce the data required to develop this program. *By Dr. R. W. Drisko*

Steel structures in seawater are very susceptible to corrosion. CEL has conducted an investigation into use of protective coatings to deter such corrosion. Investigation has concentrated on the atmospheric, tidal, and submerged areas of steel piling. Field experiments are now underway at Dam Neck, Va., in cooperation with the National Bureau of Standards and the Army's Construction Engineering Research Laboratory, and at Port Hueneme.

Several protective coating systems have been found that provide excellent long-term protection to steel piling. A cofferdam system has been developed allowing painting several feet below mean low water, a very corrosive location on piling. A military specification has been prepared for a viscous protective coating material that can be applied by hand to steel piling between tides and underwater. Lower viscosity coatings have been developed that can be applied to steel surfaces underwater by brush or roller. *By Dr. R. W. Drisko*

Existing utility lines under piers and wharves of naval shore facilities are subject to severe corrosion from the marine atmosphere, resulting in high maintenance or replacement costs. CEL is currently researching and developing new techniques to protect these underpier lines. Each type of line poses its own problems.

Plastic-coated steel and fiberglass-reinforced plastic pipes, lacking the toughness of steel, are subject to abrasion and impact damage. CEL has designed and is testing a new type of corrosion-resistant, plastic-coated pipe hanger to reduce damage to the usual steel pipe hangers.

Tar-and-felt covers, ordinarily wrapped around steam and hot water pipes under piers for insulation, deteriorate rapidly in these marine conditions, exposing the pipes to corrosion. Newer types of protective jacketing of aluminum, stainless steel, and various plastic coverings are being investigated and tested.

Fuel lines are often intermittently submerged in seawater at high tide in some areas, as well as exposed to high humidity and salt spray—all of which cause corrosion. The problem is compounded duirng maintenance by the difficulty of preparing a good surface before recoating. CEL is testing several protective coatings and wrapping tapes to increase service life and help cut maintenance and pipe replacement costs.

Several newly designed pipe hangers, protective jacketing materials, and coating specimens have been placed in the field and exposed on racks at Kwajalein, Kaneohe, and Port Hueneme. Behavior of the exposed materials in the field are to be correlated with Laboratory findings on adhesion, flexibility, tensile strength, flammability, and resistance of these materials to salt spray, impact, and weather. *By E. S. Matsui.*

All structures at Naval shore establishments are subject to corrosion and deterioration from their natural environments and must be protected to minimize deterioration and costly repairs. The cost of metal corrosion alone at U.S. military and industrial establishments is more than $10 billion annually.

Painting is the most widely used, simple, and low cost method for protecting large surface areas. With advances in paint technology, coating manufacturers have developed many formulations. However, those coating systems must be carefully investigated and selected according to the surface materials to be painted, the type of surface preparation to be used, conditions under which they are to be applied, the severity of the exposure, and service required.

To get best performance from the coating systems and to extend the useful life of naval structures, the Laboratory is conducting investigations to increase knowledge of mechanisms by which coating systems perform and degrade. Research on protective coating systems for metal, wood, and masonry involves in-laboratory investigations of performance —such as adhesion, water and ion permeability, electrical properties, tensile properties, and hardness—to determine their importance and the degree to which they interact to produce high coating performance or to cause coating failure.

To supplement, validate, and correlate the laboratory research, coating systems are weathered at different experimental field locations, permitting determination of coating performance and of failure characteristics and causes under varying environmental conditions. *By E. S. Matsui and Dr. R. L. Alumbaugh.*

A simulated underpier pipe coated with an experimental protective film is tested for resistance to splashes.

ON ADVICE OF COUNSEL

By WILLIAM H. SPECK
Counsel
HQNAVFAC

Litigation was described by Ambrose Bierce (no friend of lawyers) as a process by which a person sacrifices his skin to save his bones. And those sued quickly learn the aptness of the description. Heavy costs strike first, for lawyers charge $40-$75 or more per hour, transcript on a timely basis costs $2.80 per page, and other charges are in proportion. Then, they face demands for discovery to produce all files for study, and to submit themselves and associates to examination and cross-examination in depositions, so that no privacy remains. They find themselves sued so that plaintiffs can develop their case by "fishing expeditions" in discovery. The suits drag on month after month into years: each step takes 30 days or more for brief and response; and an appeal takes a whole year. Meantime, work may be in abeyance because a judge has enjoined, the parties have agreed to suspend, or defendents dare not proceed until sure. And the outcome is uncertain, sometimes depending upon which judge or panel gets the case, with Courts of Appeals from different circuits taking different positions, and with the U.S. Supreme Court dividing 5-4 or without even one common majority opinion. And losing can halt work in the millions and cost thousands of dollars per day in suspension. The Government is considered to have the "deep pocket" able to pay any amount. To crown more than frustration, even the United States may be assessed plaintiffs' attorneys fees, and government officers can be subject to personal liability.

Yet litigation—an attempt to resolve disputes on a rational basis by the submission of evidence from both sides, arguments pro and con, and the decision by experienced, impartial judges in terms of published rules of law in written opinions subject to review—is still better than any alternative. Trial by battle, decision by omens (ducking, scorched hands, etc.), resolution by influence and favor, decision by lay "peoples courts," or arbitration have little to recommend them.

Lawyers for the Government try to avoid even the possibility of litigation by urging procedures and courses that minimize differences; e.g., open competitive bidding or negotiation, independent audit or GAO decision. More aware of costs and delays, they may adopt the view, there never is good litigation or a bad settlement. They concur with Judge Learned Hand: "I must say that, as a litigant, I should dread a lawsuit beyond almost anything else short of sickness and death."

Books and Essays as viewed by

T. C. MURPHY
Director, Engineering Management Division
CECOS

The Fall, 1974 issue of *ORBIS* contains an omnibus discussion (eight articles by eminent authorities) of vital national defense issues, probably the most penetrating available.

1. Strategic Adaptability
2. Flexible Response Options
3. The Essence of Armed Futility
4. Foreign Policy and the Strategic Balance
5. The Deterrence Continuum
6. Maneuver instead of Mass: The Key to Assured Stability.
7. Population Vulnerability: The Neglected Issue in Arms Limitation and the Strategic Balance
8. Lessons of the Strategic Bombing Survey for Contemporary Defense Policy.

It is hard to imagine a more worthy anthology for the serious military professional.

Another article of interest:

THE MELLON'S, THE MAFIA, AND A COLONIAL COUNTY; in the Washington Monthly, June 1975; pg. 46-61

How many times have we recently heard women exhorted, encouraged, invited to become more active politically? Participatory democracy, we're told, is the way to salvation.

Well, there was this girl in Westmoreland County, Pennsylvania, named Dorothy Shope, who did it; and for a very simple, down-to-earth, community issue: rising property taxes.

First she founded ACT — Association of Concerned Taxpayers — then got several thousand signatures on a petition to the county commissioners, calling for a freeze on property tax rates; and when the commissioners threw it into the waste basket, she ran for, and won, the office of county commissioner. *That took care of the participatory.*

Now, about the democracy . . .

You won't believe — you won't *want* to believe what happened to Dorothy on the way to property tax equity. It was not just a case of Davidia and Goliath, because in this case, Goliath was not only large and powerful, but:

1. Invisible/amorphous
2. Rich; *very* rich
3. Devious
4. Possessed of "cousins" who kept popping up out of (and from under) all sorts of places/rocks, all wearing various disguises, such as:
   a. De judge
   b. The free press
   c. District attorney
   d. A leading property tax appraisal company of the nation.

I guess it is an example of what is/was — now, cynically, then heroically — referred to as the American Way of Life. All brought to you by the same folks who brought you *The Tweed Story, Teapot Dome,* and *Watergate.*

The end of the Westmoreland County story is not written yet; but one thing is certain, whenever it is, Dorothy Shope will be able to write a book about participatory democracy. I hope she does. It will be a big book.

I can't imagine a better textbook for a civics class. If the school board approves it.

NOTES and EDITOR'S COMMENTS

• LAST ISSUE: Readers of the Spring edition of *The Navy Civil Engineer* may have (not) noticed that an article concerning "Saving Energy at NOD Crane" appearing on page 16 was titled incorrectly. The editorial staff was apparently *NOD*ding (naval ordnance depot) when it should have been *NAD*ding (naval ammunition depot) . . . However, this relatively minor goof became academic, when, upon receipt of an advance copy of the issue, officials of the installation at Crane, Ind., hurriedly advised us that the title was incorrect — the facility had been redesignated the Naval Weapons Support Center (NWSC) on 1 July 1975. So, forget "Saving Energy at *NOD (NAD),* Crane" and think "Saving Energy at *NWSC,* Crane." Thank you . . . . . Another editorial crime appearing in the same edition was incorrectly referring to *LCDR* James E. Daly, NSCC, as *LT* James E. Daly, NSCC, as commanding officer of the BEN MOREELL Sea Cadet Battalion, featured on pages 24-25. Sorry, Jim. Oh, well, we can't lose them all!

• THIS ISSUE we introduce what we trust will be a welcome feature to our pages: *SEAbee STORIES* (see below) and encourage all readers to consider contributing similar anecdotes, vignettes, or whatever. The subject need not be limited to Seabees per se, but any area of military or civilian assignment or experience, past or present, that the contributor believes should be shared. Please limit the contributions to 500 words, typed, double spaced with the contributor's full name, address and electric telephone number. So, we invite you to participate. "Remember the time that ---------" Let us hear about *that* time.

• NOW IS THE TIME for all good (wo)men to come to the aid of their . . . museum! *Hark Ketels,* director of the CEC/Seabee Museum, located at the Construction Battalion Center, Port Hueneme, advises us that he is frustrated and near exhaustion in a search for an authentic Navy officer's uniform, circa WW-ONE or period 1918. The uniform (as illustrated) is, of course, Navy blue, with choker collar and parallel braid running down the front of the jacket and continuing around the jacket bottom. Ideally, the uniform should be the CEC Navy uniform. The CEC oak-leaf device, however, during this particular era, was considerably larger than that of the present day. The cap was of pill-box roundness with short visor and cap cover only slightly extended from cap support sides. The museum director has contacted many sources (other repositories, costume makers, personal contacts, et al) without succuss. The particular uniform is a missing link in the new Uniform and Arms Wing of the CEC/Seabee Museum. We request reader assistance, as we have successfully in the past, in locating the actual uniform or reasonable substitute. If you have any ideas please convey them directly to: *Hark Ketels, Director, CEC/Seabee Museum, Code 2232, Construction Battalion Center, Port Hueneme, CA 93043, or call commercially collect (805) 982-5163 or Autovon 360-5163.*

Sea(bee) Stories

The Captain's Cap

BY LCDR MICHAEL D. PORTER, CEC, USN
Executive Officer, Naval School Civil Engineer Corps Officers

The miniature naval officer's cap device has been traditionally worn on working caps such as the garrison cap and Seabee green cap.

However, in 1968 a change was issued so that the collar grade insignia would be worn on the green cap by Seabee officers to reduce confusion experienced by other services in visually determining the grade of an officer.

Repeated recommendations had been made to change the miniature cap device to the grade insignia for Seabee green caps, but each recommendation had been turned down, maintaining the tradition of the naval officers cap device, *that is until . . .*

It was January 1968 in Camp Haskins, North Da Nang, RVN, when Delta Company, NMCB-58, was completing experimental bunker construction. This job led to the arrival of the 12th NMCB in RVN for the added construction effort needed to produce a large quantity of these bunkers for the Vietnamization program in the Northern I Corps.

General Westmoreland, Commander, Military Assistance Command, Vietnam (MACV), had visited Camp Haskins three times over a three-week period for review of the experimental bunkers built for demonstration by LTJG Terry O'Neil's men. Rear Admiral Bartlett, Com3NCB; Captain Goetske, 3NCB representative/Saigon; Captain Turner, Com30NCR and Commander deGroot, CONMCB58, were there, tense and anxious to achieve what was desired for another big step forward in the growing tactical support rendered by the MCBs.

On the third visit General Westmoreland turned to the Vietnamese General and they agreed that the fighting and living bunkers would be used in the northern area. At that moment General Westmoreland turned to Rear Admiral Bartlett and said, "Give me 2400 of these." The Admiral replied, "I'll need another battalion of Seabees." The General responded, "Get one."

Ten days later NMCB-4 was upon us in Camp Haskins. Within seconds the General turned to board his helicopter but paused after second thought to shake hands with the "troops."

Standing in line was our CO, Commander deGroot. I heard General Westmoreland exclaim as he shook our CO's hand, "Good job, *Chief,*" (looking at his cap insignia) "or *whatever you are.*"

The controversy over to wear or not to wear the naval officer's cap device or rank insignia had finally reached the top commander and he, too, was confused.

Within two days, all Seabee officers wore the rank insignia, and you were there — January 1968.

Naval Facilities Engineering Command
SITUATION REPORT

REFUSE-TO-ENERGY STUDIES - NAVFAC studies on conversion of refuse-to-energy at ten (10) naval activities show potential for significant savings in present fossil fuel consumption and facility operating costs. Although all the studies have not been completed, preliminary results indicate a possible reduction of a total of 1.14 million barrels per year and $7.8 million annual operating costs at the ten sites surveyed. The studies will be completed this summer.

NEW DEFINITIVES FOR BACHELOR QUARTERS - NAVFAC has developed two new definitive designs for BEQs and two new definitive designs for BOQs. The BEQ designs are interior corridor type with 3-man rooms, private baths, and central lounges. One design is a 3-story building and the other is a high rise building with elevators. One BOQ design is an interior corridor (hotel) type and the other is a balcony (motel) type. These designs are currently being distributed.

STRUCTURAL STEEL DOLPHINS - NAVFAC has developed designs for structures in water depths up to 70 ft where timber dolphins are inadequate in strength, where greater energy absorption is required, and where durability of dolphins is an issue. Report with examples of calculations for various field requirements is available in NAVFACHQ.

CONDENSATE RETURN STUDY - For years, many naval activities chose to discard steam condensate return from central steam distribution systems rather than return it to the central heating plants. It was more cost effective to waste the condensate than to replace the short lived, expensive condensate pipe systems. Now, the increase in the fuel cost and the availability of better return pipe materials make the waste practice a questionable one. A study of this problem at five typical installations is now being undertaken by NAVFACHQ. Completion of the study is expected by February 1976.

SOIL DATA RETRIEVAL SYSTEM - NAVFAC is developing a rapid data retrieval system for soils and geological information for use by NAVFACHQ and field divisions. This effort is being carried out through contract with a soil testing service.

Naval Facilities Engineering Command
SITUATION REPORT

FIREFIGHTING SCHOOL SMOKE ABATEMENT CRITERIA - Criteria development has been completed for the control of smoke from new Fleet Training Center Fire Fighting Schools which will reduce fuel costs associated with the afterburner to an insignificant amount. Criteria on treatment of wastewater from firefighting schools is under development and is expected to be completed by September. New criteria on a smoke abatement system for aircraft crash/rescue firefighting training is also under development.

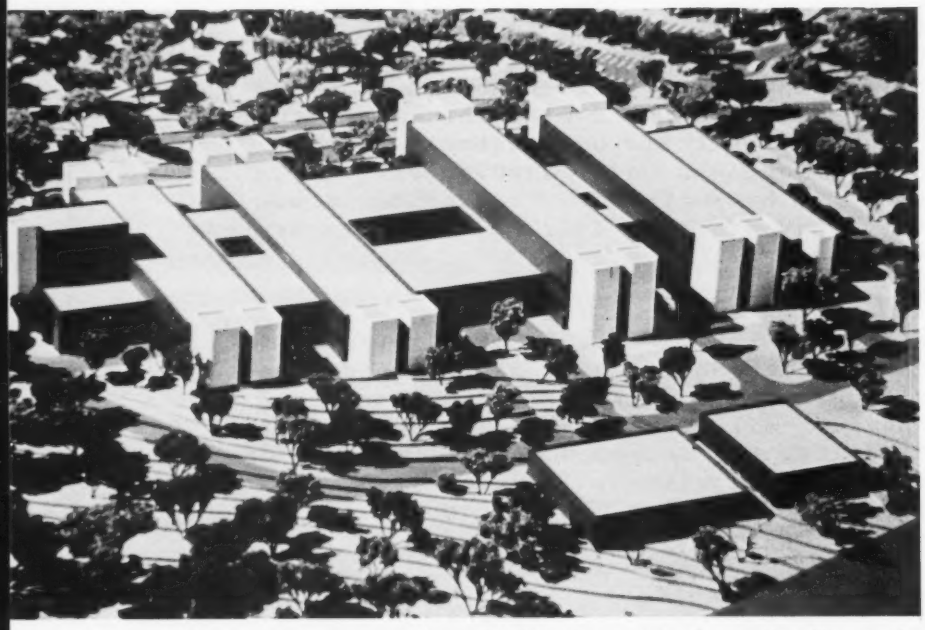
OILY WASTES HANDLING AND DISPOSAL - A research and engineering company, under contract to NAVFAC, has recently completed its survey and evaluation of the oily wastes handling at 17 different naval facilities in the U.S. and overseas. A separate report, detailing the recommendations for handling, treating and disposing of these wastes, has been produced for each facility. Projects to implement these recommendations will begin in the near future.

FULL-DEPTH ASPHALT AIRFIELD PAVEMENT DESIGN - NAVFAC presently has an engineering investigation contract underway to modify the Asphalt Institute full-depth asphalt pavement design procedures to accommodate Navy aircraft with their high tire pressures and single wheel loads. The work is being done by Dr. M. W. Witczak who is uniquely qualified since he developed the Asphalt Institute's full-depth asphalt pavement design procedure. It is anticipated that this material will be available in draft form about October 1975. It is planned to incorporate these design procedures in the Tri-Service Flexible Pavement Design Manual now being prepared by the Civil Engineering Laboratory.

CONSTRUCTION ENGINEERING HANDBOOK, P-455 - A revision of the engineering part of 1954 TP-Ad-5, "Inspection of Construction Contracts" consists of 15 separate books based on the 16 divisions of construction specifications established by Construction Specifications Institute. Examples: "Site Work," "Concrete," "Mechanical." Each book gives basic engineering understanding of subject, points out potential problem areas for inspector's particular attention. Dated July 1974, P-455 is in distribution; copies also available by MILSTRIP from U.S. Naval Publications and Forms Center, Philadelphia. Particularly recommended as refresher on basics of almost any engineering found in facilities construction.

Homeport for the TRIDENT

By LCdr John F. Conroy
OICC Trident



Artist's concept of the facility planned for Trident crew training. Construction of the complex is already underway at Bangor, Wash.

The *Trident* System, planned and designed as the successor to the *Polaris* and *Poseidon* Systems as the primary strategic deterrent for the United States, is a three-pronged system comprised of a new submarine, a new missile, and a dedicated shore support facility.

The shore facility, identified as the *Trident* Support Site, will be built on the existing Naval Ammunition Depot at Bangor, Washington.

The planning, programming, design, and construction details of the *Trident* Support Site are being accomplished by the Naval Facilities Engineering Command under the direction of the Officer in Charge of Construction (OICC-*Trident*), Capt. E. R. Stacey, CEC, USN.

Environmental considerations favored construction of an offshore "delta" dock for Trident.

The OICC *Trident* organization is divided into two segments with offices on the east and west coasts. The east coast office in Alexandria, Va., directs the overall *Trident* construction effort including the programming and budgeting aspects.

The west coast office, in Bremerton, Wash., under the direction of Cdr. J. R. Dunn, CEC, USN, Deputy OICC *Trident*, administers the design and construction phases of the program. Design of all new facilities will be accomplished by architect-engineer firms throughout the United States by standard negotiated fixed price contracts.

Engineering and design costs for the entire *Trident* military construction program will approach $45 million, and it is estimated that the value of construction for the 100 separate construction projects will be in excess of *$600 million.*

First step in the construction of the *Trident* Support Site was the preparation of a master plan and an environmental impact statement. The preparation of these detailed documents was undertaken concurrently to permit influence of environmental considerations on the master plan. As that plan was being developed, the impact on the environment was evaluated and necessary changes were made. Both documents are now completed and design and construction of the *Trident* Support Site are proceeding.

The requirement of a construction program of $600 million over the relatively short period of six to eight years has necessitated the establishment within OICC *Trident* of five Resident Officer in Charge of Construction (ROICC) organizations. Each of these ROICCs is manned by a commander or lieutenant commander and a staff of approximately twelve civilian specialists. The responsibility of these ROICCs has been divided to coincide with the major functional areas of the base as follows: waterfront, training facility, missile assembly and support, utilities and site improvements and industrial and base support.

A sixth ROICC will be required to support a new ammunition pier as well as other support facilities at the Indian Island Annex to the Naval Torpedo Station, Keyport located approximately 20 miles north of the *Trident* Support Site.

Along the *Trident* waterfront area are facilities, which will cost approximately $150 million. These facilities are very large, unique structures, two of which are covered explosive handling wharves which are required for the onloading and offloading of the *Trident* missiles. Each wharf is approximately 640 feet long with a 120-ton bridge crane and will be covered, to permit all-weather operations necessary to maintain the stringent refit schedule of the submarines. At their highest point, these covers will rise 155 feet above the Hood Canal.

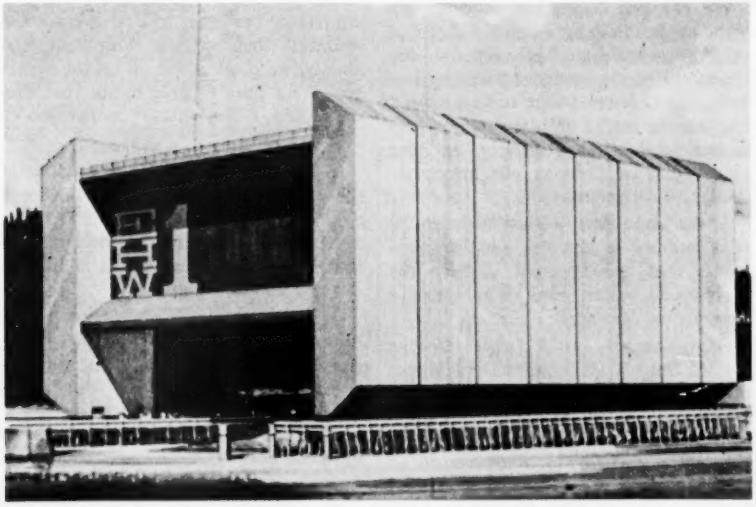
Also included in the waterfront area are two refit piers and a drydock at which maintenance operations for the *Trident* submarine will be performed. Each pier is approximately 700 feet in length, and along with the drydock, will form a triangle commonly referred to as the Delta configuration. The Delta's northernmost apex will extend 1,500 feet into the Hood Canal and will be constructed in approximately 115 feet of water.

Contributing to the complexity of

construction along the waterfront were a multitude of environmental impact considerations not the least of which were the concern for salmon fingerlings which must swim in relatively shallow water along the shoreline and the impact that dredging would have on the abundant shellfish in the Hood Canal. These factors prevented building the refit piers and drydock along the shore in the usual finger pier configuration, but rather required these facilities, to be offshore, with bridging trestles which would not impede the salmon.

Additional waterfront facilities include a service pier to permit berthing of small craft to support the torpedo and docking operations at the *Trident* support site, and a magnetic silencing facility to deperm and degauss the submarine.

To provide the initial and refresher training for the crews of the submarines, a $30 million training facility will be constructed as an integral part of the support site. The magnitude and complexity of this building, which will encompass an area of 300,000 square feet, is indicated in the fact that the building will house $120 million of training equipment, most of which is a duplicate of that actually used on the *Trident* submarine.



This building will serve as an explosives handling facility at the Trident complex.

This expensive and highly sensitive submarine equipment necessitates stringent environmental conditions within the structure and as a result has required installation of complex building support systems in the design. This building is the first major facility to be started at the Bangor site.

To save time and to meet a very tight schedule, it was necessary to award the foundation contract for the structure separately and have these foundations constructed a year in advance of the superstructure. Additionally, early procurement of long lead times was initiated to insure the arrival of critical items in sufficient time to meet the construction schedule of the superstructure.

The third major functional area at the support site consists of the missile assembly and missile support functions. Construction in this area amounts to approximately $80 million. The initial increment of this construction is currently underway with the construction of interim security fences which are required to allow the construction crews access to the site while still maintaining adequate security at on-going *Polaris* operations. In these facilities, the components of the missile will be assembled into a fully operational tactical missile which can be directly loaded onto the *Trident* submarine.

Construction in this area will be one of the first to be completed, as production of the missile must start well in advance of deployment of the submarine to allow sufficient time for flight testing of the missile which will be accomplished at the Air Force Eastern Test Range, Cape Canaveral, Fla.

The magnitude of the utilities and site improvements systems to be constructed in the fourth major segment of the support site is impressive. Planned at an approximate cost of $130 million, this construction effort includes 80 miles of all-weather roads, 44 miles of water distribution systems and 16 miles of sewage distribution systems. There will also be 13.8 miles of primary electrical distribution of 115KV and 34 miles of secondary distribution at 12.5KV which will require six 12.5KV substations.

Construction of these utilities has been programmed to assure that adequate utilities will be available as each of the facilities is completed. Also included in the utility construction package are four heating plants with outputs ranging from 10,000 to 195,000 lbs. per hour. The largest boiler plant is designed with a dual fuel utilization system for oil and coal. Included in one of the utilities package is a monitoring system that will have 30,000 input points and will provide monitoring of such items as: fire detection and intrusion detection alarms, environmental systems, energy conservation variables, and HVAC monitoring systems throughout the site.

The site improvements portion of the construction includes 300,000 square yards of paving, 1,474 acres of improved grounds and 500 acres of semi-improved grounds.

The last major area in the *Trident* support site complex is the industrial and base support area. This area contains those common facilities necessary for the operation of any naval activity. Presently programmed in this area are five bachelor enlisted quarters, one bachelor officer quarters, an administration building, public works facilities, enlisted dining facilities, enlisted personnel clubs and several other personnel support facilities. The estimated cost for these facilities is approximately $80 million.

Although the major construction effort for the *Trident* System is concentrated in the Pacific northwest, there is another facet of the system to be located on the east coast. This will be the *Trident* missile flight test facilities which are now being built at the Air Force Eastern Test Range at Cape Canaveral, Fla., under the direction of the Southern Division of the Naval Facilities Engineering Command. These facilities total $35 million and were included in the FY 1974 Military Construction Program.

The major *Trident* facility being constructed at Cape Canaveral is a new wharf and turning basin. This facility is sited to provide sufficient explosive safety distance between it and existing facilities and a deeper channel and turning basin for the *Trident* submarine.

While the *Trident* construction program extends from FY 1974 through FY 1979, and work at the *Trident* support site will extend into 1980, the necessary support facilities will be ready to support the scheduled deployment of the first *Trident* submarine in April 1979.

SPEAKING FROM TOPSIDE

Did you know that in the late 1800's there was a serious proposal to abolish the U.S. Patent Office, because "everything of importance has now been invented?"

Sometimes there is a tendency to think that "the facilities business" is pretty much solved and running by itself, that there is nothing really new under the sun.

Not so! Not so at all.

We are just beginning to recognize some of the challenges that lie ahead of us. For example, we have seen only the tiniest tip of the ocean engineering iceberg. Ten years from today, ocean engineering might well be a major part of our total effort. Similarly, we have only begun to fight in our attack on energy consumption.

At the same time, we are in the midst of a number of changes and improvements that are designed to help the Navy to do better, even in a period of diminishing resources.

For example, on 1 July 1975 we formed the MUSE Support Detachment of the NNPU (Naval Nuclear Power Unit) and located the Detachment — some twenty Seabees strong — at Port Hueneme, California. This group of highly qualified and specially trained Seabees, together with five experienced civil service personnel, who previously were with the MUSE Field Office, are responsible for the total field operation of the Navy's $70 million worth of mobile generators, substations, boilers, and related gear.

Why is the MUSE change important? Because for the past ten years, NAVFAC has been busy buying, borrowing, scrounging and deploying these assets — to meet Fleet cold iron needs, to handle isolated station continuing needs, to assist in meeting short term utility requirements of temporary and permanent bases, and to respond to Navy power failures anywhere, worldwide. Every fleet commander and every major claimant knows what MUSE is, what MUSE is doing for him, and wants more of it.

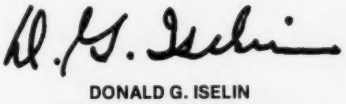
Now, however, we must have a systematic overhaul and replacement program for this equipment; we must check out units — wherever they are — before we ship them to their new locations; we must often train Navy and contractor crews on how to operate and maintain their specific equipment; and finally, we must check up on the operators from time to time to see that they are doing a reasonably proper job in running our gear.

In the big picture, the upgrading of the MUSE effort could be considered as a minor change. But to the CO of a destroyer who wants to go cold iron at the only pier available to him in Greece, it is mighty important.

Of more dramatic proportion is the recent consolidation of five major public works departments in the San Francisco Bay area into the Public Works Center, San Francisco — 1200 employees and $30 million worth of business completed in their first year. A real achievement! *The Navy's nine PWC's now do $350 million in business each year — one-third of the Navy's total public works effort — and they do it with only 99 officers and 12,000 civilians!*

Many of you have participated in the two-week junior officers' refresher put on by CECOS. Almost all of the comments that we receive on this program are favorable. Now we are planning to carry it a step further. CECOS is currently developing a two-week seminar for the LCDR level, which will discuss the concept of NAVFAC's Command Management Plan and will

Let's Look Ahead...



DONALD G. ISELIN
Rear Admiral, CEC, U.S. Navy
Deputy Chief of Civil Engineers
Vice Commander, Naval Facilities
Engineering Command

study in some detail the Navy Facilities System and its various subsystems, such as the CMS (Construction Management System), PWC MIS (Public Works Center Management Information System), SFPPS (Shore Facilities Planning & Programming System), as well as the Seabee Management System, Equipment Management System, and Resources Management System.

In many respects, this will be a "look ahead" course rather than a refresher course. This course will be particularly valuable to our mid-career officers because of the diversity of their billets and because their CO's will logically expect them to be knowledgeable on all aspects of the Civil Engineer Corps' business.

Speaking of the Command Management Plan, this document, by which we guide NAVFAC's operations, has undergone some fundamental changes in its current issue (CMP-76). For one thing, the format has been changed to show two types of "goals" — *one a true goal or target,* such as "award 80% of current year MILCON projects by 30 June"; the other type a workload estimate, such as "perform 150 validation reviews of budget-year MILCON projects". These latter estimates frequently relate to externally imposed work required to assist stations, major claimants, and Commandants.

A second change in the CMP is an increased emphasis on reporting back the actual experience against the specific goals. This will permit a performance assessment with respect to the true targets and goals, and a measure of how the externally imposed workload is trending in each of the EFD's and NAVFAC-wide.

Robert Lovett said, *"good judgment is the result of experience; and experience is the result of bad judgment."* For three years now NAVFAC has been conducting an extensive follow-up program to determine the operation and maintenance performance of our newly completed large hospitals. From these reviews our engineers and their medical associates are generating a number of changes in criteria for the hospitals currently under design.

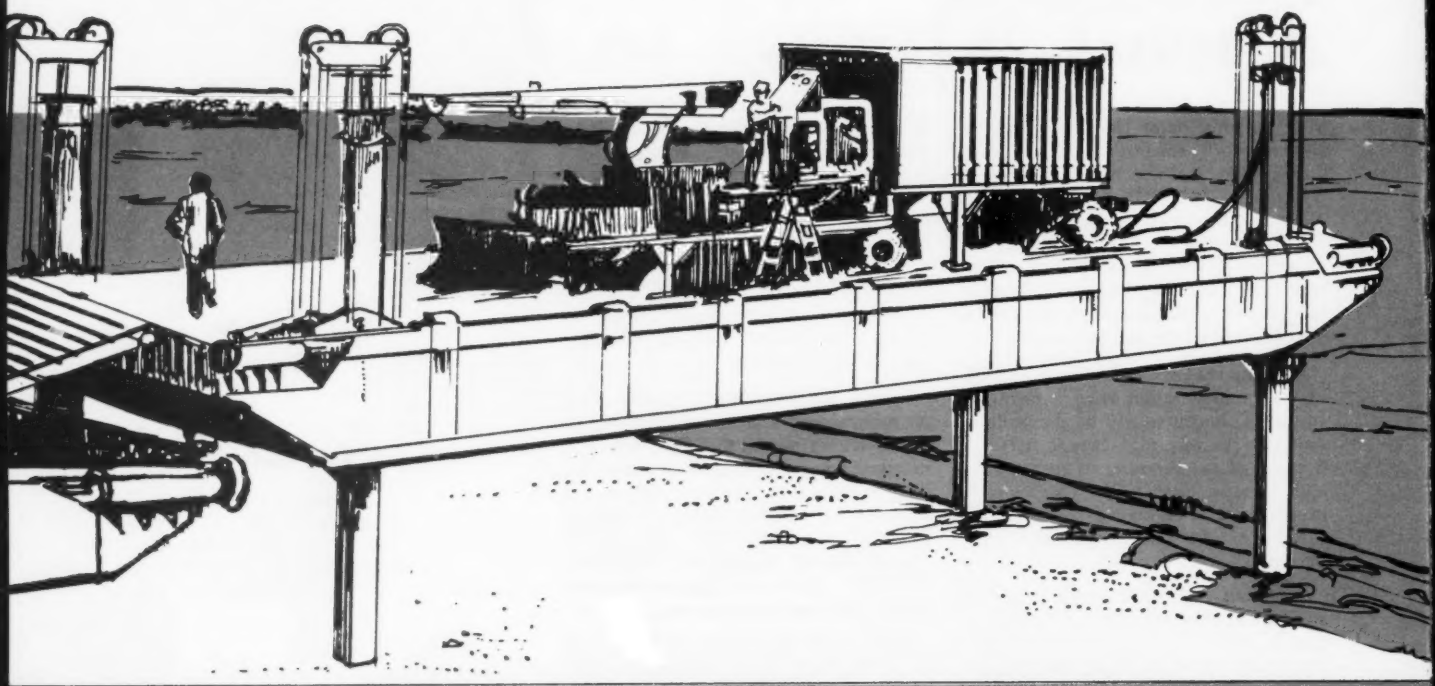
In this way, we hope to benefit from past experience and not lose the value of lessons learned in this field. We will shortly extend this program of *product improvement* by making follow-up evaluations for BEQ's, training facilities, messhalls, and three other categories of repetitive facilities. NAVFAC, EFD and sponsor reps will comprise the evaluation teams.

Other important areas in which all of us are now deeply involved — and which are either new to the facilities arena or have taken on explosively larger emphasis in the past few years are:

- Pollution Abatement
- Energy Conservation — from the engineering standpoint
- Regional and Area-wide Master Planning
- AICUZ Program (Air Installations Compatible Use Zone)

All of the above changes are but samples of the type of progress and modernization that is being made by many people at every level in the Navy's facilities business.

The challenges are many. Admittedly, the resources will stretch only so far. The trick is for each of us to know his (her) business and his (her) people well enough that each of us gets a high "Facilities Return" for each dollar we spend.



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